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March 2001

# Final Environmental Impact Statement Marigold Mine Expansion Project



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*Management is based upon the principles of multiple use and sustained yield of our nation's resources within a framework of environmental responsibility and scientific technology. These resources include recreation, rangelands, timber, minerals, watershed, fish and wildlife, wilderness, air and scenic, scientific, and cultural values.*

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# United States Department of the Interior

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In Reply Refer To:
1793/3809
NV-020

March 9, 2001

Dear Reader:

This Final Environmental Impact Statement (FEIS) for the Glamis Gold, Marigold Mine expansion, prepared by the Bureau of Land Management (BLM), Winnemucca Field Office is submitted for your review and comment.

The FEIS is based on a Plan of Operations submitted to the BLM under 43 CFR 3809 regulations. The FEIS analyzes the direct, indirect and cumulative impacts related to expansion of existing mine facilities (pits, overburden dumps & heap leach pads) and development of the 8-North and 5-North deposits, including construction of new pits, new overburden disposal areas, additional heap leach facilities, new tailing impoundment, drainage diversions, haul and exploration roads, and ancillary facilities

Alternatives analyzed include the Proposed Action, No Action, and the 8-South Partial Pit Backfill alternative. The Plan of Operations, Draft EIS (DEIS), and applicable technical reports are available for review at this office.

Comments were received on the DEIS during the 60 day comment period, which ended April 10, 2000. Public meetings were held on the DEIS in Winnemucca and Battle Mountain, Nevada on March 8, 2000 and March 9, 2000.

This FEIS contains in its entirety the analysis originally presented in the Draft EIS (issued February 11, 2000), with all text changes highlighted. Also included in the FEIS are responses to comments received during the public comment period on the Draft EIS.

Comments on this FEIS will be accepted until the close of business April 9, 2001. Written comments or questions may be directed to Jeff Johnson, Environmental Coordinator, at the Bureau of Land Management, Winnemucca Field Office, 5100 East Winnemucca Boulevard, Winnemucca, Nevada 89445.

Sincerely,

Terry A. Reed
Field Manager

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# FINAL
# ENVIRONMENTAL IMPACT STATEMENT
# MARIGOLD MINE EXPANSION PROJECT

| | |
|---|---|
| **Lead Agency:** | U.S. Department of the Interior<br>Bureau of Land Management<br>Winnemucca Field Office |
| **Project Location:** | Humboldt County, Nevada |
| **Comments on this EIS Should be Directed to:** | ***Jeff Johnson***<br>EIS Project Manager<br>Bureau of Land Management<br>Winnemucca Field Office<br>5100 East Winnemucca Blvd.<br>Winnemucca, NV 89445<br>(775) 623-1500 |
| **Date Draft EIS Filed with EPA:** | February 11, 2000 |
| **Date Final EIS Filed with EPA:** | March 9, 2001 |

## ABSTRACT

Glamis Gold, Inc./Rayrock Mines, Inc., doing business as Glamis Marigold Mining Company (GMMC) proposes to construct new facilities and expand existing gold mining operations at the Marigold Mine in Humboldt County, Nevada. The mine is located on public and private lands near Interstate Highway 80 approximately 13 miles northwest of Battle Mountain and approximately 40 miles southeast of Winnemucca.

The proposed Marigold Mine Expansion Project would disturb approximately 462 acres of private land and 255 acres of BLM-administered public land, for a total of 717 acres. The proposed project would include: expansion of two pits and development of two new pits; expansion of two waste rock dumps and development of two new waste rock dumps; addition of lifts to three existing heap leach cells, addition of one cell to an existing leach pad, and development of a new heap leach facility; expansion of the tailings impoundment and construction of a new tailings impoundment; haul roads, solution ponds, growth media stockpiles, exploration drill pads and access roads, and diversion channels; and realignment of a public access road (Buffalo Valley Road) and power line. The Proposed Action would extend the mine operations an additional 5 years through ***2007***.

***This Final Environmental Impact Statement provides responses to comments received by BLM during the public comment period on the Draft Environmental Impact Statement (Draft EIS). The Draft EIS analyzed the environmental effects of the Marigold Mine Expansion Project, the 8-South Partial Pit Backfill Alternative, and the No Action Alternative.***

**Responsible Official for EIS:**

Douglas Dodge

for Terry A. Reed
Field Office Manager
Winnemucca Field Office

# SUMMARY

## PROPOSED ACTION

Glamis Marigold Mining Company (GMMC) proposes to construct new facilities and expand existing gold mining operations in Humboldt County, Nevada. The mine is located on public and private lands near Interstate Highway 80 (I-80) approximately 13 miles northwest of Battle Mountain and approximately 40 miles southeast of Winnemucca, Nevada. GMMC has been operating the Marigold Mine since 1988. Historical mining in the proposed project vicinity dates back to 1927. To date, approximately 1,349 acres have been disturbed.

A Plan of Operations Amendment and Reclamation Plan for the proposed Marigold Mine expansion was submitted to the Bureau of Land Management (BLM) in August 1998. Current mine facilities consist of a series of pits, waste rock dumps, a heap leach pad and associated processing plant, a tailings impoundment, access and haul roads, and ancillary facilities. The proposed Marigold Mine Expansion Project would disturb approximately 462 acres of private land and 255 acres of BLM-administered public land, for a total of 717 acres. The proposed project would include: expansion of two pits and development of two new pits; expansion of two waste rock dumps and development of two new waste rock dumps; addition of lifts to three existing heap leach cells, addition of one cell to an existing leach pad, and development of a new heap leach pad; expansion of the tailings impoundment or construction of a new tailings impoundment; haul roads, solution ponds, growth media stockpiles, exploration drill pads and access roads, and diversion channels; and realignment of a public access road (Buffalo Valley Road) and power line. The Proposed Action would extend the mine operations an additional 5 years, through ***2007***. Reclamation and monitoring would continue through ***2017***.

## ALTERNATIVES

This environmental impact statement (EIS) analyzes the direct, indirect, cumulative, and residual environmental impacts of the Proposed Action, 8-South Partial Pit Backfill Alternative, and the No Action Alternative. The alternatives are described in the following sections.

### 8-South Partial Pit Backfill Alternative

The 8-South Partial Pit Backfill Alternative would include the backfilling of the existing 8-South Pit with waste rock originating from the proposed 8-North Pit. This alternative would eliminate the need to construct the 8-North Waste Rock Dump (85 acres) thereby decreasing total disturbance to 632 acres.

### No Action Alternative

Under the No Action Alternative, currently permitted operations at the Marigold Mine would cease after 2001, with final reclamation extending 10 years beyond closure. Additional minerals in the project area would remain undeveloped, and no construction or expansion of mine pits, waste rock dumps, heap leach pads, tailings impoundment, or other ancillary facilities would occur.

## IMPORTANT ISSUES AND IMPACT CONCLUSIONS

A small number of issues were raised during scoping for this EIS. Public scoping meetings were held in Battle Mountain and Winnemucca, Nevada, on October 6 and 7, 1998, respectively. Additional issues were identified by resource specialists during the preparation of the EIS. These issues along with their impact conclusions are presented below. Impact conclusions include the implementation of mitigation measures that have been identified. These measures are presented in detail in Chapter 3.0 of this EIS for each affected resource.

## Water Resources and Geochemistry

*Issue*: Formation of a pit lake as a result of mine development and impacts to wildlife from degraded water quality.

*Conclusion*: The construction and development of the 8-North Pit would not occur unless the price of gold is $400 per ounce or greater. If the pit is developed, it would only be mined to a depth that would not intercept groundwater; no pit lake would form.

*Issue*: Impacts to surface water and groundwater levels resulting from pit dewatering and groundwater use for mine operations.

*Conclusion*: Based on the evaluation of historic and current groundwater level data within the project vicinity, hydrologic impacts to springs or intermittent creeks located in the project vicinity are not anticipated. Springs and intermittent creeks located in the project vicinity would not be affected since the water source for the springs and intermittent creeks is not hydrologically connected with the bedrock aquifer. No pit dewatering is anticipated during mining. Water used for the proposed mine operations would be obtained from the Lone Tree Mine and supplemented with the water from water supply wells in the project vicinity. The source of water for the water supply wells is ***mainly*** the bedrock aquifer, whereas the source of water for the springs and intermittent creeks is ***shallow alluvium*** and surface flows resulting from runoff.

*Issue*: Long-term stability of diversion channels.

*Conclusion*: The diversion channels would be designed and constructed to accommodate a 100-year storm event.

*Issue*: Degradation of surface water from heap leach expansion and tailings impoundment.

*Conclusion*: Perennial streams and springs do not exist within the project area. Intermittent creeks exist within the project area and convey water only during seasonal snowmelt or heavy precipitation events. Heap leach facilities and the tailings impoundment would be designed to contain potential contaminants (e.g., cyanide solution). These facilities would be closed systems with no release of solutions to areas outside the facilities. Therefore, no impacts to surface water are expected.

*Issue*: Degradation of groundwater quality.

*Conclusion*: Geochemical testing indicates that waste rock from the mine does not have a potential to generate acidic seepage. Seepage from waste rock dumps may be elevated in arsenic and mercury, but would not be expected to reach groundwater due to the low permeability of the soil and the depth to groundwater (about ***80*** feet). The current tailings remediation plan at the existing tailings impoundment is expected to reduce seepage to groundwater and keep any impacts to groundwater within State drinking water standards. A new tailings impoundment may be constructed if the 8-North and 5-North ***Pit*** deposits are mined. This impoundment would ***have a low permeability base***

***consisting of compacted clay or a geosynthetic liner.***

## Air Quality

*Issue*: Cumulative impacts to air quality.

*Conclusion*: The annual and 24-hour contributions from the mine sources would not cause the air quality in the region to degrade below National or State ambient air quality standards.

## Vegetation Resources

*Issue*: Loss of wetland or riparian areas resulting from the construction of the diversion structures.

*Conclusion*: Wetlands or riparian areas would not be affected within or adjacent to the project area.

*Issue*: Potential long-term impacts to the Humboldt River and wetlands near its terminus.

*Conclusion*: The project area does not include perennial creeks or rivers. Therefore, no impacts to the Humboldt River or wetlands located adjacent to the river would be affected by mine expansion. Potential impacts to groundwater and surface water would be limited to the mine site and immediate vicinity.

*Issue*: Minimize the spread of noxious weeds.

*Conclusion*: GMMC has committed to use seed ***that has been tested for noxious weed seeds prior to application,*** and control or eradicate any weed infestations during mine operation and reclamation.

*Issue*: Utilize native species in reclamation seed mixes.

*Conclusion*: ***The interim seed mix would include crested wheatgrass, which is a non-native species. This species would be used since it readily establishes on disturbed sites and reduces soil erosion.*** The ***permanent reclamation*** seed mix to be used during reclamation would consist primarily of native species. These mixes were developed as a result of past and current revegetation studies and successful reclamation conducted at the mine site.

*Issue*: Reclamation of the proposed tailings impoundment.

*Conclusion*: GMMC has committed to reclaim the proposed tailings impoundment area after mining operations cease. After reclamation has been completed, the area would be monitored for several years to evaluate reclamation success.

## Wildlife and Fisheries Resources

*Issue*: Wildlife habitat disturbed or lost.

*Conclusion*: No riparian habitat would be affected. Loss of upland habitat would not exceed 717 acres. The value of habitat lost would be low to moderate, due to the proximity of the project to past and present disturbances and activities and the availability of native habitats in the surrounding region. Approximately 656 acres of disturbed habitat would be reclaimed.

*Issue*: Loss of mule deer winter range.

*Conclusion*: A total of 717 acres of mule deer winter range would be removed for the life of the project.

*Issue*: Direct mortalities, habitat fragmentation, and animal displacement.

*Conclusion*: Direct mortalities would be limited. Incremental habitat fragmentation would occur and terrestrial wildlife would be displaced for the life of the project.

*Issue*: Impacts to resident and migratory birds.

*Conclusion*: Potential effects to breeding birds (e.g., passerines, raptors) could occur from incremental habitat loss, disturbance to nesting habitat, and increased noise and human presence, particularly from mine exploration activities. These impacts would be minimized by the applicant committed protection measures. Effects to upland game birds would be minor, based on relative habitat value, bird species occurrence, and committed protection measures.

*Issue*: Measures to prevent wildlife exposure to cyanide solutions on heaps, in solution channels, and ponds should be developed.

*Conclusion*: Potential impacts from cyanide ingestion would be low, since bird netting would be installed over the solution ponds ***and GMMC would monitor heap leach pads to avoid the puddling of cyanide solution***.

## Special Status Species

*Issue*: Potential impacts to special status species.

*Conclusion*: With the exception of sensitive bat species, no sensitive plant or wildlife species would be affected. The implementation of the committed environmental protection measures would minimize impacts to sensitive bats.

## Range Resources

*Issue*: Loss of available grazing land and interference in ranch management activities resulting from the construction of the range perimeter fence.

*Conclusion*: Construction of the range perimeter fence would remove 5,762 acres of rangeland available for grazing resulting in the temporary loss of 288 animal unit months. A permanent loss of 6 animal unit months would result after mine reclamation.

*Issue*: Construction of the diversion structures may affect water available for livestock.

*Conclusion*: Segments of Trout and Cottonwood creeks located within the project area have intermittent flows and are used by livestock as seasonal water sources. The construction of the diversion structures would alter the configuration of these creeks. However, these creeks would still be available for seasonal use by livestock during mine operation. In addition, Ames and Mud springs are located within the general vicinity of the

intermittent creeks and would continue to provide water sources for livestock during mine operation.

## Land Use and Access

*Issue*: Proposed realignment of the Buffalo Valley Road and responsibility for long-term maintenance.

*Conclusion*: Construction and maintenance of the proposed road realignment would be coordinated with Humboldt County and the BLM.

*Issue*: Proposed realignment of the power line and coordination of construction activities with Sierra Pacific Power Company (SPPCo).

*Conclusion*: If realignment is required, GMMC would pursue ROW applications with SPPCo and the BLM.

*Issue*: Increased traffic on haul and access roads.

*Conclusion*: Average daily traffic volumes on local roadways, including I-80, are not expected to change significantly from current levels as a result of the proposed project.

*Issue*: Legality of mine claims within the project area.

*Conclusion*: GMMC complies with the BLM Instruction Memorandum No. 98-154, as the proposed mine expansion would not exceed the legal limit of 5 acres of mill site claims for each associated lode claim.

## Aesthetics (Visual and Noise Resources)

*Issue*: Visual contrasts with elements of the characteristic landscape in exceedence of BLM Visual Resource Management (VRM) objectives.

*Conclusion*: The Proposed Action and the 8-South Partial Pit Backfill Alternative would result in moderate contrasts with existing forms, lines, and textures of the characteristic environment as a result of the construction of the new heap leach facility and expansion of the waste rock dumps. These contrasts would exceed VRM objectives during the life of mining. If proposed reclamation efforts were successful, visual contrasts would be reduced to acceptable levels within 10 years of the reclamation period.

## Cultural Resources, Ethnography, and Paleontology

*Issue*: Direct physical disturbance of cultural resources or traditional use sites that are listed on or are eligible to the National Register of Historic Places or are protected under state or other Federal statutes.

*Conclusion*: Environmental protection measures involving cooperation between GMMC, the BLM, the State Historic Preservation Officer, and the Advisory Council on Historic Preservation would be implemented if cultural resources are discovered or affected during construction or operation activities. Based on the protection measures, proper steps would be taken to evaluate the quality of the resource, to determine whether the

loss is acceptable, and to mitigate losses that are not acceptable. Known sites in the project area would be avoided by mining and exploration activities. No traditional use sites have been identified in the mine area.

*Issue*: Impacts to significant paleontological resources.

*Conclusion*: Significant fossil-bearing formations have not been identified in the project area to date. Committed environmental protection measures designed to reduce impacts to previously unidentified paleontological resources that may be located during the mine expansion would be implemented.

## AGENCY-PREFERRED ALTERNATIVE

In accordance with the National Environmental Policy Act, Federal agencies are required by the Council on Environmental Quality (40 Code of Federal Regulations 1502.14) to identify their preferred alternative for a project in the Draft EIS, if a preference has been identified, and in the Final EIS prepared for the project. The preferred alternative is not a final agency decision; it is rather an indication of the agency's preliminary preference. The alternative identified below is the BLM's preferred alternative at the ***Final*** EIS stage in the environmental review process. This preference may be changed based on the agency and public comments that are received on this ***Final*** EIS. The BLM's preference at this time considers all information that has been received and reviewed relevant to the proposed project. The agency-preferred alternative is the ***8-South Partial Pit Backfill Alternative*** as described in the EIS with all appropriate mitigation.

## CONTENTS

**1.0 INTRODUCTION ..... 1-1**
1.1 Mine History ..... 1-1
1.2 Existing Operations ..... 1-4
1.3 Proposed Action ..... 1-4
1.4 Purpose of and Need for the Proposed Action ..... 1-8
1.5 Relationship to BLM and Non-BLM Policies, Plans, and Programs ..... 1-8
1.6 Authorizing Action ..... 1-9
1.7 Organization of the Environmental Impact Statement ..... 1-9

**2.0 PROPOSED ACTION ..... 2-1**
2.1 Introduction ..... 2-1
2.2 Proposed Action ..... 2-1
2.2.1 Work Force and Schedule ..... 2-7
2.2.2 Mining Operations ..... 2-7
2.2.2.1 Open Pit Development ..... 2-7
2.2.2.2 Surface Water Diversions ..... 2-10
2.2.2.3 Loading and Hauling ..... 2-14
2.2.3 Roads ..... 2-14
2.2.3.1 Access Roads ..... 2-14
2.2.3.2 Haul Roads ..... 2-14
2.2.3.3 Public Access Road Relocation ..... 2-14
2.2.4 Waste Rock ..... 2-14
2.2.4.1 Waste Rock Dumps ..... 2-14
2.2.4.2 Pit Backfill ..... 2-15
2.2.5 Heap Leach Facilities ..... 2-15
2.2.5.1 Heap Leach Design and Construction ..... 2-15
2.2.5.2 Solution Ponds/Collection System ..... 2-17
2.2.5.3 Leach Pad Leak Detection/Collection System ..... 2-17
2.2.6 Ore Crushing Plant ..... 2-17
2.2.7 Process Area ..... 2-19
2.2.8 Tailings Impoundments ..... 2-21
2.2.9 Growth Media Stockpile Areas ..... 2-22
2.2.10 Storm Water Control ..... 2-22
2.2.11 Water Supply ..... 2-23
2.2.12 Electric Power ..... 2-23
2.2.13 "In Fill" Areas ..... 2-23
2.2.14 Security and Fencing ..... 2-24
2.2.15 Fire Protection ..... 2-24
2.2.16 Exploration Drilling Pads, Access Roads, and Sumps ..... 2-24
2.2.17 Hazardous Materials and Wastes ..... 2-24
2.2.17.1 Reagent Transport and Storage ..... 2-24

## CONTENTS (Cont'd)


2.2.17.2 Spill Prevention and Emergency Response ..... 2-26
2.2.17.3 Waste Management ..... 2-26
2.2.18 Environmental Protection Measures and Monitoring ..... 2-27
2.2.18.1 Sediment Control ..... 2-27
2.2.18.2 Waste Rock Characterization ..... 2-27
2.2.18.3 Spill Prevention Sampling ..... 2-27
2.2.18.4 Stability of Facilities ..... 2-28
2.2.18.5 Wildlife and Livestock Protection ..... 2-28
2.2.18.6 Air Quality ..... 2-29
2.2.18.7 Cultural/Paleontological Resources ..... 2-29
2.2.18.8 Employee Environmental Education Program ..... 2-30
2.2.19 Reclamation ..... 2-30
2.2.19.1 Growth Media Stockpiling and Use ..... 2-34
2.2.19.2 Grading and Stabilization ..... 2-34
2.2.19.3 Surface and Seedbed Preparation ..... 2-34
2.2.19.4 Seed Mixtures and Rates ..... 2-34
2.2.19.5 Shrub Plantings ..... 2-35
2.2.19.6 Weed Control ..... 2-35
2.2.19.7 Reclamation Schedule ..... 2-35
2.2.19.8 Facility Reclamation ..... 2-36
2.3 8-South Partial Pit Backfill Alternative ..... 2-40
2.4 No Action Alternative ..... 2-40
2.5 Alternatives Considered but Eliminated from Detailed Analysis ..... 2-40
2.6 Interrelated Projects ..... 2-48
2.6.1 Past and Present Actions ..... 2-50
2.6.2 Reasonably Foreseeable Future Actions ..... 2-50
2.7 Summary Comparison of Impacts Between the Proposed Action, 8-South Partial Pit Backfill Alternative, and No Action Alternative ..... 2-52
2.8 Agency-Preferred Alternative ..... 2-52

**3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES ..... 3-1**
3.1 Water Resources and Geochemistry ..... 3-2
3.1.1 Affected Environment ..... 3-2
3.1.1.1 Waste Rock Geochemistry ..... 3-2
3.1.1.2 Surface Water Resources ..... 3-8
3.1.1.3 Water Rights ..... 3-14
3.1.1.4 Groundwater Resources ..... 3-14
3.1.2 Environmental Consequences ..... 3-26
3.1.2.1 Proposed Action ..... 3-27
3.1.2.2 8-South Partial Pit Backfill Alternative ..... 3-33
3.1.2.3 No Action Alternative ..... 3-33

## CONTENTS (Cont'd)


3.1.3 Cumulative Impacts ..... 3-34
3.1.4 Potential Mitigation and Monitoring ..... 3-35
3.1.5 Residual Adverse Impacts ..... 3-36
3.2 Geology and Minerals ..... 3-37
3.2.1 Affected Environment ..... 3-37
3.2.1.1 Regional Geological Setting ..... 3-37
3.2.1.2 Stratigraphy ..... 3-37
3.2.1.3 Structure ..... 3-43
3.2.1.4 Mineralization ..... 3-43
3.2.1.5 Mining History ..... 3-43
3.2.1.6 Oil, Gas, and Geothermal Development ..... 3-44
3.2.1.7 Seismicity ..... 3-44
3.2.1.8 Geological Setting of the Marigold Mine Area ..... 3-49
3.2.2 Environmental Consequences ..... 3-49
3.2.2.1 Proposed Action ..... 3-49
3.2.2.2 8-South Partial Pit Backfill Alternative ..... 3-50
3.2.2.3 No Action Alternative ..... 3-50
3.2.3 Cumulative Impacts ..... 3-50
3.2.4 Potential Mitigation and Monitoring ..... 3-55
3.2.5 Residual Adverse Impacts ..... 3-55
3.3 Air Quality ..... 3-56
3.3.1 Affected Environment ..... 3-56
3.3.1.1 Climatology and Meteorology ..... 3-56
3.3.1.2 Air Quality ..... 3-57
3.3.2 Environmental Consequences ..... 3-62
3.3.2.1 Proposed Action ..... 3-62
3.3.2.2 8-South Partial Pit Backfill Alternative ..... 3-66
3.3.2.3 No Action Alternative ..... 3-66
3.3.3 Cumulative Impacts ..... 3-66
3.3.4 Potential Mitigation and Monitoring ..... 3-66
3.3.5 Residual Adverse Impacts ..... 3-66
3.4 Soils ..... 3-67
3.4.1 Affected Environment ..... 3-67
3.4.1.1 Detailed Study Area ..... 3-67
3.4.1.2 General Study Area ..... 3-74
3.4.2 Environmental Consequences ..... 3-75
3.4.2.1 Proposed Action ..... 3-75
3.4.2.2 8-South Partial Pit Backfill Alternative ..... 3-80
3.4.2.3 No Action Alternative ..... 3-80
3.4.3 Cumulative Impacts ..... 3-80

## CONTENTS (Cont'd)


3.4.4 Potential Mitigation and Monitoring ..... 3-81
3.4.5 Residual Adverse Impacts ..... 3-81
3.5 Vegetation Resources ..... 3-83
3.5.1 Affected Environment ..... 3-83
3.5.1.1 Vegetation ..... 3-83
3.5.2 Environmental Consequences ..... 3-84
3.5.2.1 Proposed Action ..... 3-84
3.5.2.2 8-South Partial Pit Backfill Alternative ..... 3-87
3.5.2.3 No Action Alternative ..... 3-87
3.5.3 Cumulative Impacts ..... 3-87
3.5.4 Potential Mitigation and Monitoring ..... 3-87
3.5.5 Residual Adverse Impacts ..... 3-88
3.6 Wildlife and Fisheries Resources ..... 3-89
3.6.1 Affected Environment ..... 3-89
3.6.1.1 Aquatic Biology ..... 3-89
3.6.1.2 Terrestrial Wildlife ..... 3-89
3.6.2 Environmental Consequences ..... 3-91
3.6.2.1 Proposed Action ..... 3-91
3.6.2.2 8-South Partial Pit Backfill Alternative ..... 3-94
3.6.2.3 No Action Alternative ..... 3-94
3.6.3 Cumulative Impacts ..... 3-94
3.6.4 Potential Mitigation and Monitoring ..... 3-95
3.6.5 Residual Adverse Impacts ..... 3-95
3.7 Special Status Species ..... 3-96
3.7.1 Affected Environment ..... 3-96
3.7.1.1 Plants ..... 3-96
3.7.1.2 Birds ..... 3-97
3.7.1.3 Mammals ..... 3-99
3.7.2 Environmental Consequences ..... 3-101
3.7.2.1 Proposed Action ..... 3-101
3.7.2.2 8-South Partial Pit Backfill Alternative ..... 3-103
3.7.2.3 No Action Alternative ..... 3-103
3.7.3 Cumulative Impacts ..... 3-103
3.7.4 Potential Mitigation and Monitoring ..... 3-103
3.7.5 Residual Adverse Impacts ..... 3-103
3.8 Range Resources ..... 3-104
3.8.1 Affected Environment ..... 3-104
3.8.2 Environmental Consequences ..... 3-108
3.8.2.1 Proposed Action ..... 3-108
3.8.2.2 8-South Partial Pit Backfill Alternative ..... 3-108
3.8.2.3 No Action Alternative ..... 3-108

## CONTENTS (Cont'd)


3.8.3 Cumulative Impacts ..... 3-108
3.8.4 Potential Mitigation and Monitoring ..... 3-109
3.8.5 Residual Adverse Impacts ..... 3-109
3.9 Land Use and Access ..... 3-110
3.9.1 Affected Environment ..... 3-110
3.9.1.1 Land Use ..... 3-110
3.9.1.2 Rights-of-Way ..... 3-110
3.9.1.3 Access ..... 3-111
3.9.2 Environmental Consequences ..... 3-114
3.9.2.1 Proposed Action ..... 3-114
3.9.2.2 8-South Partial Pit Backfill Alternative ..... 3-115
3.9.2.3 No Action Alternative ..... 3-115
3.9.3 Cumulative Impacts ..... 3-115
3.9.4 Potential Mitigation and Monitoring ..... 3-115
3.9.5 Residual Adverse Impacts ..... 3-115
3.10 Recreation ..... 3-116
3.10.1 Affected Environment ..... 3-116
3.10.2 Environmental Consequences ..... 3-116
3.10.2.1 Proposed Action ..... 3-116
3.10.2.2 8-South Partial Pit Backfill Alternative ..... 3-117
3.10.2.3 No Action Alternative ..... 3-117
3.10.3 Cumulative Impacts ..... 3-117
3.10.4 Potential Mitigation and Monitoring ..... 3-117
3.10.5 Residual Adverse Impacts ..... 3-117
3.11 Aesthetics ..... 3-118
3.11.1 Affected Environment ..... 3-118
3.11.1.1 Visual Resources ..... 3-118
3.11.1.2 Noise ..... 3-121
3.11.2 Environmental Consequences ..... 3-121
3.11.2.1 Proposed Action ..... 3-121
3.11.2.2 8-South Partial Pit Backfill Alternative ..... 3-124
3.11.2.3 No Action Alternative ..... 3-124
3.11.3 Cumulative Impacts ..... 3-124
3.11.4 Potential Mitigation and Monitoring ..... 3-125
3.11.5 Residual Adverse Impacts ..... 3-125
3.12 Social and Economic Values ..... 3-126
3.12.1 Affected Environment ..... 3-126
3.12.1.1 Population And Demography ..... 3-126
3.12.1.2 Economy, Employment, and Income ..... 3-128
3.12.1.3 Housing and Community Services ..... 3-132

## CONTENTS (Cont'd)


3.12.1.4 Government and Public Finance ..... 3-135
3.12.2 Environmental Consequences ..... 3-138
3.12.2.1 Proposed Action ..... 3-138
3.12.2.2 8-South Partial Pit Backfill Alternative ..... 3-141
3.12.2.3 No Action Alternative ..... 3-141
3.12.3 Cumulative Impacts ..... 3-142
3.12.4 Potential Mitigation and Monitoring ..... 3-143
3.12.5 Residual Adverse Impacts ..... 3-144
3.13 Hazardous Materials ..... 3-145
3.13.1 Affected Environment ..... 3-145
3.13.2 Environmental Consequences ..... 3-149
3.13.2.1 Proposed Action ..... 3-149
3.13.2.2 8-South Partial Pit Backfill Alternative ..... 3-150
3.13.2.3 No Action Alternative ..... 3-150
3.13.3 Cumulative Impacts ..... 3-150
3.13.4 Potential Mitigation Measures ..... 3-150
3.13.5 Residual Adverse Effects ..... 3-150
3.14 Cultural Resources, Ethnography, and Paleontology ..... 3-151
3.14.1 Affected Environment ..... 3-151
3.14.1.1 Cultural Resources ..... 3-151
3.14.1.2 Ethnography and Native American Consultation ..... 3-161
3.14.1.3 Paleontology ..... 3-164
3.14.2 Environmental Consequences ..... 3-166
3.14.2.1 Proposed Action ..... 3-166
3.14.2.2 8-South Partial Pit Backfill Alternative ..... 3-171
3.14.2.3 No Action Alternative ..... 3-171
3.14.3 Cumulative Impacts ..... 3-172
3.14.3.1 Cultural Resources ..... 3-172
3.14.3.2 Native American Concerns ..... 3-173
3.14.3.3 Paleontology ..... 3-173
3.14.4 Potential Mitigation and Monitoring ..... 3-173
3.14.5 Residual Adverse Impacts ..... 3-174
3.15 Relationship Between the Local Short-Term Uses of the Human Environment and the Maintenance and Enhancement of Long-Term Productivity ..... 3-175
3.16 Irreversible/Irretrievable Commitment of Resources ..... 3-176

**4.0 CONSULTATION AND COORDINATION ..... 4-1**
4.1 Public Participation ..... 4-1
4.2 Native American Consultation ..... 4-1
4.3 Draft Environmental Impact Statement Preparation ..... 4-2
4.4 Final Environmental Impact Statement Review ..... 4-2

## CONTENTS (Cont'd)

4.5 Public Comment Letters and Responses ..... 4-7

**5.0 LIST OF PREPARERS AND REVIEWERS ..... 5-1**

**6.0 REFERENCES ..... 6-1**

**ACRONYMS ..... A-1**

**GLOSSARY ..... G-1**

**INDEX ..... I-1**

**APPENDIX A – BLM'S HEAP LEACH CLOSURE POLICY AND GUIDELINES**

**APPENDIX B – WATER RESOURCES AND GEOCHEMISTRY SUPPLEMENTAL DATA**

**APPENDIX C – REPRESENTATIVE WILDLIFE SPECIES IN THE VICINITY OF THE MARIGOLD MINE**

**APPENDIX D – VISUAL SIMULATIONS AND BLM VISUAL CONTRAST RATING WORKSHEETS**

**APPENDIX E – CULTURAL RESOURCES SITES TABLES**

**APPENDIX F – CULTURAL RESOURCES SIGNIFICANCE CRITERIA**

## LIST OF TABLES


| | | |
|---|---|---|
| **1-1** | Marigold Mine Existing and Approved Facilities | 1-7 |
| **1-2** | Mining Claims Summary | 1-10 |
| **1-3** | Major Permits and Approvals Required for the Marigold Mine Expansion Project | 1-12 |
| **2-1** | Acres of Existing Permitted Disturbance | 2-2 |
| **2-2** | Estimated Acres of New Disturbance Under the Proposed Action | 2-2 |
| **2-3** | Existing and Proposed Heap Leach Facilities | 2-16 |
| **2-4** | Hazardous Materials Summary | 2-25 |
| **2-5** | Disturbed and Reclaimed Acreage After the Proposed Action | 2-33 |
| **2-6** | Proposed Seed Mixes | 2-35 |
| **2-7** | Acreages Disturbed and Reclaimed After the 8-South Partial Pit Backfill Alternative | 2-45 |
| **2-8** | Acreages Disturbed and Reclaimed After the No Action Alternative | 2-46 |
| **2-9** | Interrelated Project in the Marigold Mine Cumulative Assessment Area | 2-49 |
| **2-10** | Comparisons of the Proposed Action, 8-South Partial Pit Backfill Alternative, and No Action Alternative | 2-53 |
| **3-1** | Nevada Water Quality Standards | 3-7 |
| **3-2** | Trout Creek Water Quality | 3-12 |
| **3-3** | Water Rights in the Project Vicinity | 3-15 |
| **3-4** | Summary of Aquifer Tests Conducted | 3-19 |
| **3-5** | Marigold Mine Monitor Well Water Levels | 3-21 |
| **3-6** | Pit Bottom Elevations and Pit Water Levels | 3-23 |
| **3-7** | Battle Mountain Area Stratigraphic Column | 3-41 |
| **3-8** | Minimum, Maximum, and Average Temperatures (°F) Lone Tree Mine 1993 and 1994 | 3-59 |
| **3-9** | Monthly Precipitation Marigold Mine 1998 and 1999 | 3-59 |
| **3-10** | National and State Ambient Air Quality Standards | 3-61 |
| **3-11** | Marigold Mine Expansion Project Estimated Particle Size Distribution | 3-63 |
| **3-12** | Hazardous Air Pollutants (HAPs) Potential to Emit | 3-64 |
| **3-13** | Potential to Emit | 3-64 |
| **3-14** | Soil Materials Suitable for Reclamation | 3-68 |
| **3-15** | Soil Characteristics and Reclamation Suitabilities | 3-70 |
| **3-16** | Native Soil Occurrence in Proposed Disturbance Areas | 3-76 |
| **3-17** | Available Soil Resources for Use as Growth Media | 3-79 |
| **3-18** | Special Status Wildlife Species Identified for the Proposed Project | 3-97 |
| **3-19** | Livestock Grazing Permits for the North Buffalo and Copper Canyon Allotments | 3-106 |
| **3-20** | Range Improvements for the North Buffalo and Copper Canyon Allotments | 3-107 |
| **3-21** | Existing Rights-of-Way Within the Project Area | 3-111 |
| **3-22** | BLM Visual Resource Management Classes | 3-119 |
| **3-23** | Study Area Population | 3-127 |
| **3-24** | Lander County Labor Force Summary | 3-129 |
| **3-25** | Humboldt County Labor Force Summary | 3-130 |
| **3-26** | Trends in Assessed Valuation and Taxable Sales – Humboldt and Lander Counties | 3-137 |
| **3-27** | CERCLA Reportable Quantities | 3-146 |

## LIST OF TABLES (Cont'd)


| | | |
|---|---|---|
| **3-28** | Cultural Resource Inventories Completed Within or Adjacent to Marigold Mine's Area of Potential Effect | 3-158 |
| **3-29** | Irreversible/Irretrievable Commitment of Resources – Proposed Action | 3-177 |
| **4-1** | Public Comment Letters | 4-8 |

## LIST OF FIGURES


| | | |
|---|---|---|
| **2-1** | Project Schedule | 2-8 |
| **2-2** | Pit Cross Sections | 2-11 |
| **2-3** | Typical Creek Diversion Cross Sections | 2-13 |
| **2-4** | Heap Leach Circuit with Carbon Columns | 2-18 |
| **2-5** | Carbon Stripping and Gold Recovery Circuit | 2-20 |
| **3-1** | Geologic Cross-Section for 8-North Pit | 3-53 |
| **3-2** | Geologic Cross-Section for 5-North Pit | 3-54 |
| **3-3** | Valmy Wind Roses January – December 1997 | 3-58 |
| **3-4** | Marigold Mine Expansion Project Monthly Regional Temperatures | 3-60 |

## LIST OF MAPS


| | | |
|---|---|---|
| **1-1** | Project Location | 1-2 |
| **1-2** | Project Vicinity | 1-3 |
| **1-3** | Existing Facilities | 1-5 |
| **1-4** | Mining Claims Map | 1-13 |
| **1-5** | Millsite and Lode Claims Affected by Existing and Proposed Operations | 1-15 |
| **2-1** | Surface Ownership | 2-3 |
| **2-2** | Proposed Action | 2-5 |
| **2-3** | Post-Reclamation Topography Under the Proposed Action | 2-31 |
| **2-4** | 8-South Partial Pit Backfill Alternative | 2-41 |
| **2-5** | Post-Reclamation Topography for the 8-South Partial Pit Backfill Alternative | 2-43 |
| **2-6** | Post-Reclamation Topography for the No Action Alternative | 2-47 |
| **2-7** | Interrelated Projects | 2-51 |
| **3-1** | Project Area Watersheds | 3-10 |
| **3-2** | Current Average Groundwater Levels | 3-16 |
| **3-3** | Location of Tailings, Wells, and Dam Piezometers | 3-25 |
| **3-4** | Post-Mining Groundwater Levels | 3-28 |
| **3-5** | General Location Map with Mines | 3-39 |
| **3-6** | Regional Geologic Map | 3-45 |
| **3-7** | Quaternary Faults in Nevada | 3-47 |
| **3-8** | Seismic Events | 3-48 |
| **3-9** | Site Geologic Map | 3-51 |
| **3-10** | Soils Types in the Project Area | 3-71 |
| **3-11** | Salvageable Soil Characteristics | 3-77 |
| **3-12** | Cumulative Assessment Area for Soils, Vegetation, and Range Resources | 3-82 |
| **3-13** | Plant Communities Within the Project Area | 3-85 |
| **3-14** | Grazing Allotments and Range Improvements | 3-105 |
| **3-15** | Existing Rights-of-Way Within the Project Area | 3-112 |
| **3-16** | Key Observation Points | 3-120 |
| **3-17** | Cultural Resource Inventories in the Area of Potential Effect | 3-155 |
| **3-18** | Cumulative Assessment Area for Cultural Resources | 3-157 |

# 1.0 INTRODUCTION

Glamis Gold, Inc./Rayrock Mines, Inc., doing business as Glamis Marigold Mining Company (GMMC), has submitted a *Plan of Operations* (POO) *Amendment and Reclamation Plan (No. N26-88-005P)* for the Marigold Mine Expansion Project (MMC 1998) to the Winnemucca Field Office of the Bureau of Land Management (BLM). GMMC prepared the amended plan for review and approval by the Nevada Department of Environmental Protection (NDEP) and the BLM. GMMC also is operating under Reclamation Permit (No. 0108), Water Pollution Control Permit (NEV88040), and the Air Quality Operating Permit (AP1041-0158).

GMMC proposes to construct new facilities and expand existing gold mining operations in Humboldt County, Nevada. The existing mining operation consists of multiple open pits and precious metal processing facilities, which are located approximately 3 miles south of Valmy, Nevada (Maps 1-1 and 1-2). The mine is located on public and private lands approximately 13 miles northwest of Battle Mountain and approximately 40 miles southeast of Winnemucca. GMMC has been operating the Marigold Mine since 1988.

## 1.1 Mine History

Mining activities began in the project area in 1927 when three claims were staked. The area covered by these claims would later be named the Marigold Mine. Three additional claims were staked in the general vicinity of the Marigold Mine in 1930. In 1936, these claims were purchased by The Marigold Mines, Incorporated, and additional claims were staked in the mine vicinity in 1940.

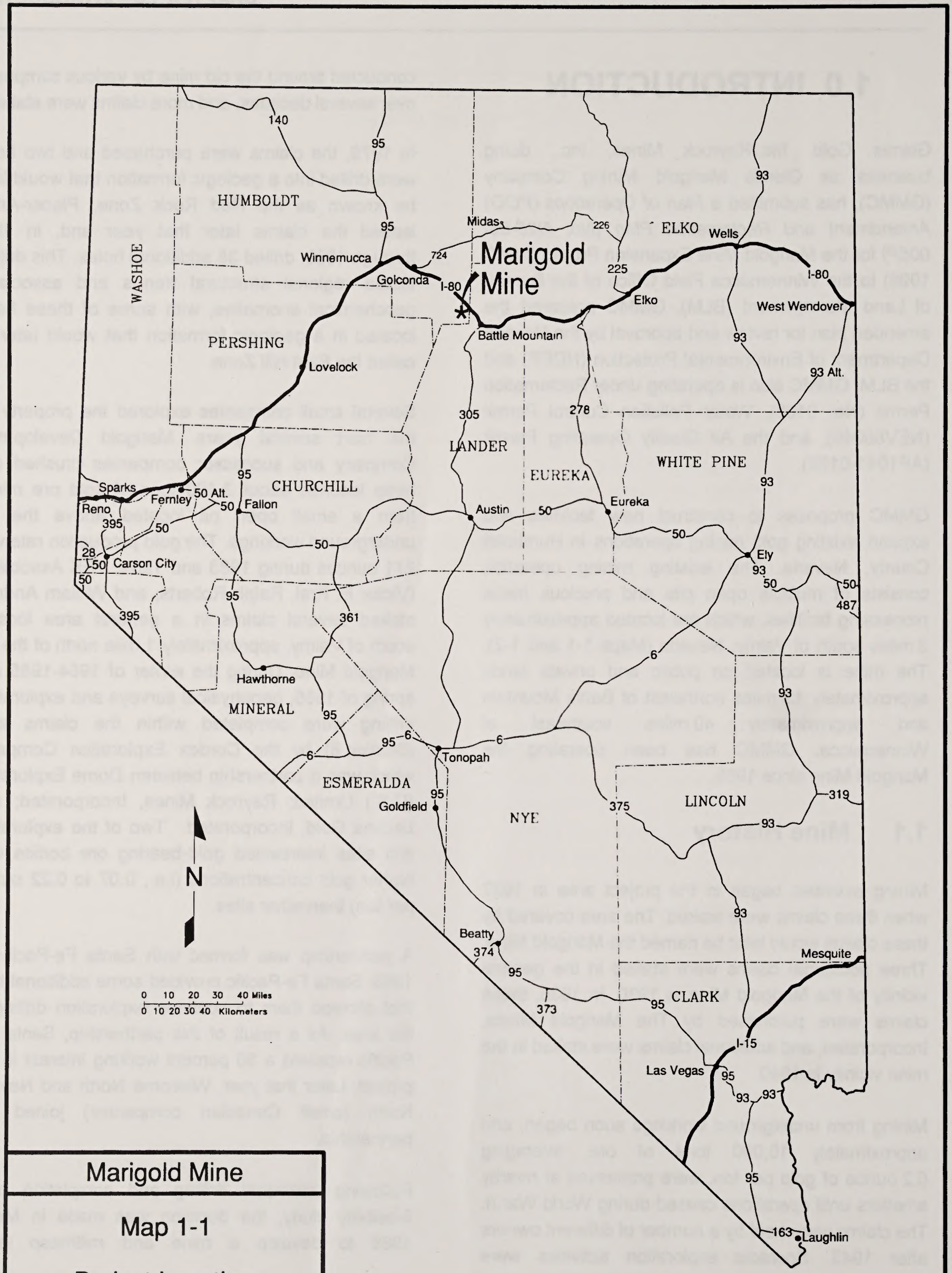
Mining from underground workings soon began, and approximately 10,000 tons of ore, averaging 0.2 ounce of gold per ton, were processed at nearby smelters until operations ceased during World War II. The claims were held by a number of different owners after 1943. Sporadic exploration activities were conducted around the old mine by various companies over several decades, and more claims were staked.

In 1979, the claims were purchased and two holes were drilled into a geologic formation that would later be known as the Red Rock Zone. Placer-Amex leased the claims later that year and, in 1979 through 1980, drilled 38 additional holes. This drilling tested regional structural trends and associated geochemical anomalies, with some of these holes located in a geologic formation that would later be called the East Hill Zone.

Several small companies explored the property for the next several years. Marigold Development Company and successor companies crushed and heap leached about 3,100 tons of gold ore mined from a small open pit located above the old underground workings. The gold production rate was 271 ounces during 1983 and 1984. VEK Associates (Victor E. Kral, Ralph Roberts, and William Andrus) staked several claims in a general area located south of Valmy, approximately 1 mile north of the old Marigold Mine. During the winter of 1984-1985 and spring of 1985, geophysical surveys and exploratory drilling were completed within the claims area (Section 8) by the Cordex Exploration Company, which was a partnership between Dome Exploration (U.S.) Limited; Rayrock Mines, Incorporated; and Lacana Gold, Incorporated. Two of the exploration drill sites intersected gold-bearing ore bodies with higher gold concentrations (i.e., 0.07 to 0.22 ounce per ton) than other sites.

A partnership was formed with Santa Fe-Pacific in 1986. Santa Fe-Pacific provided some additional land that allowed them to continue exploration drilling in the area. As a result of this partnership, Santa Fe-Pacific received a 30 percent working interest in the project. Later that year, Welcome North and Nevada North (small Canadian companies) joined the partnership.

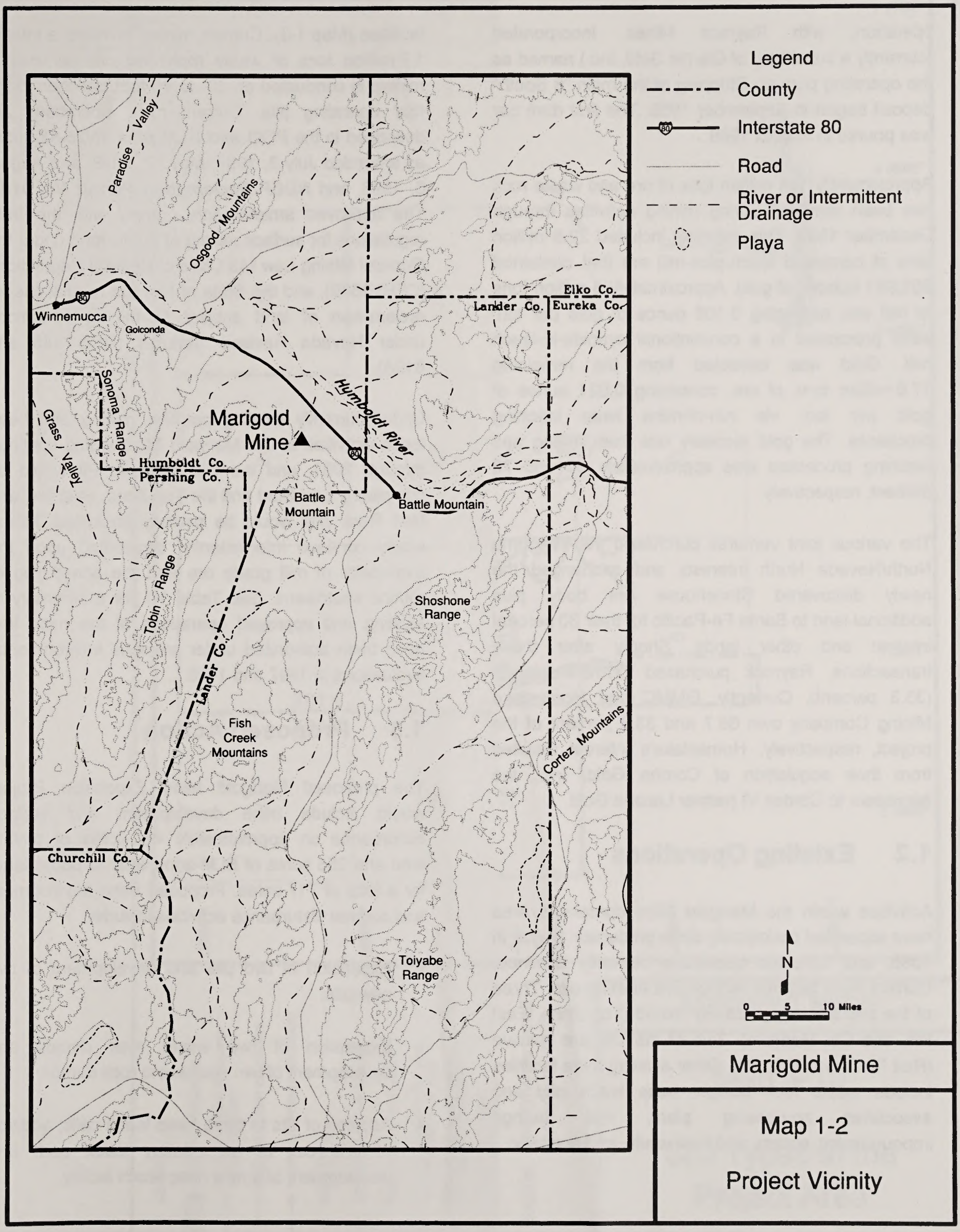
Following additional drilling and completion of a feasibility study, the decision was made in March 1988 to develop a mine and mill/heap leach




Marigold Mine

Map 1-1

Project Location




Marigold Mine

Map 1-2

Project Vicinity

operation, with Rayrock Mines, Incorporated (currently a subsidiary of Glamis Gold, Inc.) named as the operating partner. Stripping of the main "8 South" deposit began in September 1988. The first doré bar was poured in August 1989.

Approximately 124 million tons of ore and waste rock has been removed during mining activities through December 1999. This estimate included 22.6 million tons of combined leach-plus-mill ore that contained 905,981 ounces of gold. Approximately 5 million tons of mill ore, averaging 0.108 ounce of gold per ton, were processed in a conventional cyanide-in-leach mill. Gold was extracted from the remaining 17.6 million tons of ore, containing 0.021 ounce of gold per ton, via run-of-mine heap leaching processes. The gold recovery rate from milling and leaching processes was approximately 90 and 70 percent, respectively.

The various joint ventures purchased the Welcome North/Nevada North interests and exchanged the newly discovered Stonehouse ore body plus additional land to Santa Fe-Pacific for their 30 percent interest and other lands. Shortly after these transactions, Rayrock purchased Dome's interest (33.3 percent). Currently, GMMC and Homestake Mining Company own 66.7 and 33.3 percent of the project, respectively. Homestake's interest resulted from their acquisition of Corona Gold, Inc., the successor to Cordex VI partner Lacana Gold.

## 1.2 Existing Operations

Activities within the Marigold Mine operations area have expanded periodically since production began in 1988, and full-scale operations currently continue. Current mine facilities include five existing pits. Three of the pits are being actively mined (Top Zone, East Hill, and Old Marigold). Two of the pits are inactive (Red Rock and 8-South). Other existing mine facilities include waste rock dumps, heap leach pad and associated processing plant, mill, tailings impoundment, access and haul roads, and ancillary facilities (Map 1-3). Current mining involves a total of 1.7 million tons of waste rock and ore per month; mining is conducted on 20- to 40-foot benches in the four operating pits. Current mine operations are described in the POO ***and BLM plan #N26-88-005P***, as amended July 3, 1997, May 27, 1998, and August 6, 1998, and ***NDEP Reclamation Permit No. 0108***. The approved amendments comply with the BLM regulations for surface mining of public land under the General Mining Law (43 Code of Federal Regulations [CFR] 3809), and the State of Nevada regulations for reclamation of land subject to mining operations under Nevada Revised Statutes (NRS 445 and 519A).

Under currently existing permits, mining and heap leach activities at the Marigold Mine would continue through 2001, and the Old Marigold Pit would be completely backfilled and the Top Zone, East Hill, and Red Rock pits would be partially backfilled. Milling would continue intermittently, depending upon the availability of mill grade ore and the scheduling of routine shutdowns. See Table 1-1 for a summary of existing and approved operations at the mine that have been authorized under previous environmental evaluations in 1997 and 1998.

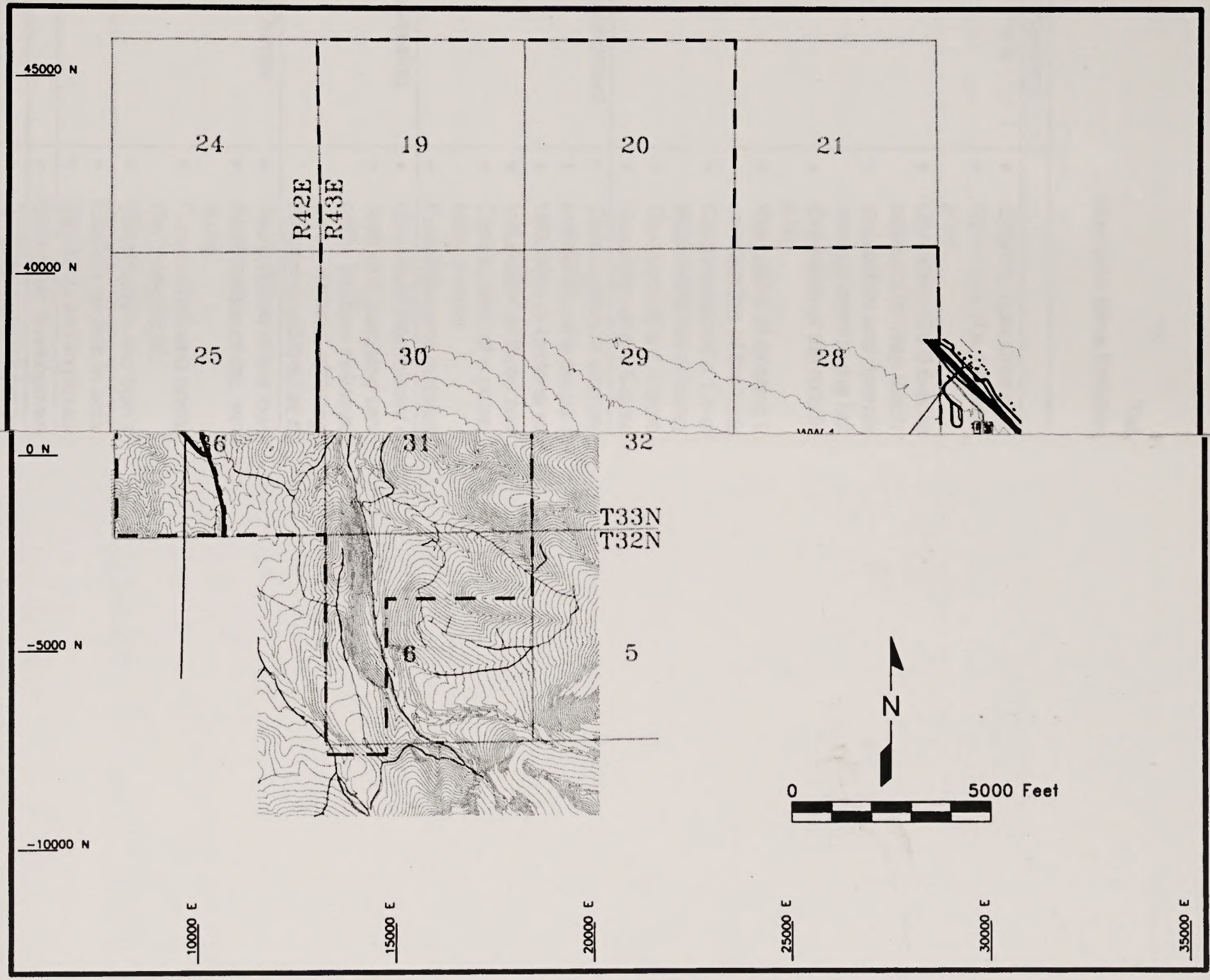
## 1.3 Proposed Action

The proposed Marigold Mine Expansion Project would include mine development and surface disturbance on approximately 462 acres of private land and 255 acres of BLM-administered public land, for a total of 717 acres. Proposed mine development and surface disturbance activities include:

- Expansion of two pits and development of two new pits;
- Expansion of two waste rock dumps and development of two new waste rock dumps;
- Addition of lifts to three heap leach cells, addition of one cell to an existing leach pad, and development of a new heap leach facility;

LEGEND

- GROWTH MEDIA STOCKPILES
- PROCESS FACILITIES
- FACILITIES, HAUL ROADS, "INFILL" AREAS, ETC.
- SURFACE WATER DIVERSIONS
- PRIVATE LAND/PUBLIC LAND CLAIM BOUNDARY
- EXISTING PERMIT BOUNDARY
- WW FRESH WATER SUPPLY WELL




Marigold Mine

Map 1-3

Existing Facilities

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- Expansion of two waste rock dumps and development of two new waste rock dumps;
- Addition of lifts to three heap leach cells, addition of one cell to an existing leach pad, and development of a new heap leach facility;




Marigold Mine

Map 1-3

Existing Facilities



**Table 1-1**
**Marigold Mine Existing and Approved Facilities**

| Mine Component | Activity |
|---|---|
| Heap Leach Pads | • Ongoing operation of heap leach cell #3 and all other cells.<br>• Operation of a 1.0-acre storm water pond, adjacent to the existing pregnant pond.<br>• Operation of a 0.6-acre hydrocarbon-contaminated soils bioremediation facility, adjacent to heap leach cell #8.<br>• Installation and operation of an overflow diversion ditch from the storm water storage pond to the tailings pond.<br>• Extension of the existing heap leach pad by approximately 20 acres; cells #9 and #10.<br>• Relocation of existing Leach Pad Monitoring Ports No. 9 and No. 10, prior to construction of the heap leach extension.<br>• Construction of a 1.5-acre heap leach detoxification rinse water storage pond adjacent to the existing barren pond.<br>• Operation of a 1.5-acre pregnant pond.<br>• Operation of a 1.5-acre barren pond. |
| Tailings Impoundment | • Construction of interceptor ditches at base of tailings dam on disturbed ground.<br>• Installation of a center interior berm with a ring dike water reclaim system.<br>• Utilization of cyclone separators to segregate tailings fractions in the pond.<br>• Installation of three new monitoring ports, TDOH No. 18, 19, & 20.<br>• Construction of a permanent containment dike on the southeast side of the tailings pond.<br>• Evaluation and installation of an in-situ tailings dewatering well. |
| Mill/***Ore Processing*** | • Continued intermittent or continuous operation of mill.<br>• ***Includes leaching tanks, thickening tank, crushing facility, rod and ball mills, carbon columns, screen separator, electrowinning units, stripping units, retorts, refining furnaces, carbon regeneration kilns; no autoclave or roaster is utilized at the mine.*** |
| Waste Rock Dumps | • Reclamation of the lower tier of Top Zone waste rock dump.<br>• Reclamation of the remaining 27 acres of disturbance on the 8-South waste rock dump.<br>• Construction and operation of an approximate 55-acre waste rock dump at the Old Marigold pit.<br>• Construction and operation of an approximate 70-acre Resort waste rock dump. |
| 8-South Pit | • Gradual decline in active mining operations.<br>• Sampling and exploration activities to be conducted in 1997 through 2001. |
| East Hill Pit | • Continued development, with possible partial backfilling of the northern portion. |
| Top Zone Pit | • Continued development, with possible partial backfilling of the northern portion. |
| Red Rock Pit | • Continued limited development, with backfilling of the northern portion with waste rock from the Top Zone and Red Rock (south) pits. |
| Old Marigold Pit | • Development of a 24-acre pit to be subsequently backfilled with waste rock from Top Zone pit development. |
| Ancillary Facilities | • Topsoil stockpiles - 20 acres at various locations.<br>• Haul roads - 60 acres throughout the project area.<br>• Water supply system - 3 water supply wells and the Lone Tree Water Line.<br>• Exploration - continued exploration and ore body delineation.<br>• Miscellaneous facilities - 3.6 acres |

- Expansion of the existing tailings impoundment, construction of a second tailings impoundment, expansion of haul roads, two solution ponds, growth media stockpiles, exploration drill pads and access roads, and diversion channels; and

- Realignment of a public access road (Buffalo Valley Road) and a power line.

The Proposed Action would extend the mine operations an additional 5 years, through ***2007***. This environmental impact statement (EIS) is prepared in compliance with the National Environmental Policy Act (NEPA), and in accordance with BLM Handbook H-1790-1 and Nevada State Office Instruction Memorandum NV-90-435 on analysis of cumulative impacts.

This EIS considers the quality of the human environment based on the physical impacts to public and private lands that may result from mining activities at the Marigold Mine. The proposed mining activities located on public lands are subject to review and approval by the BLM pursuant to the Federal Land Policy and Management Act of 1976 (FLPMA) and subsequent surface management regulations (43 CFR, Subpart 3809). These activities and their approval by the BLM pursuant to the FLPMA constitute a Federal action and are thus subject to NEPA. The BLM has determined that the proposed project constitutes a major Federal action and that an EIS would be necessary to fulfill NEPA requirements. The BLM-Winnemucca Field Office is the Federal lead agency.

## 1.4 Purpose of and Need for the Proposed Action

GMMC proposes to expand mining operations at the Marigold Mine for the purpose of extracting economically recoverable gold reserves known to exist adjacent to existing pit areas in an environmentally compatible manner. GMMC has identified the following economically driven project objectives:

- Expand processing facilities within the project area to maintain the current rate of production;

- Extract economically recoverable gold that exists in the project area;

- Operate and reclaim the project area in an efficient, environmentally conscientious, and safe manner; and

- Meet or exceed Federal, state, and local regulations for the protection of human health and safety and the environment.

The project need is reflected by the demand for gold identified in national and global markets.

## 1.5 Relationship to BLM and Non-BLM Policies, Plans, and Programs

The BLM has the authority and responsibility to manage the surface and subsurface resources on public lands within its charge. GMMC's use of public land in the Winnemucca District requires conformance with BLM's surface management regulations (43 CFR 3809), as well as various statutes, including the FLPMA, as amended. The BLM must review GMMC's plans for development to ensure the following:

- Adequate provisions are included to prevent unnecessary or undue degradation of Federal lands and to protect the non-mineral resources of the Federal lands;

- Measures are included to provide for reclamation of disturbed areas; and

- Compliance with applicable state and Federal laws is achieved.

The BLM's Sonoma-Gerlach Management Framework Plan contains no constraints that

conflict with the Proposed Action. Management activities for the Proposed Action area are identified as livestock grazing, wildlife habitat, and recreation. Mineral resource development conforms with the ***Sonoma-Gerlach*** Management Framework Plan, which states: "Make public lands and Federally owned minerals available for the exploration and development of mineral and material commodities."

BLM has reviewed GMMC's POO relative to the legal limitation on millsite claim acreages, per BLM Instruction Memorandum (IM) No. 98-154 (August 17, 1998). GMMC complies with the IM, as the proposed mine expansion would not exceed the legal limit of 5 acres of millsite claims for each associated lode claim. Lode ***and millsite*** claims within the ***private land/public land claim boundary*** are described in Table 1-2, and are ***illustrated on*** Map 1-4. ***Map 1-5 illustrates the staked millsite claims and load claims at the Marigold Mine.***

## 1.6 Authorizing Action

A Notice of Intent (NOI) to prepare the EIS was published in the Federal Register on August 31, 1998. The NOI invited public scoping comments to be sent to the BLM through November 16, 1998. Public meetings were held in Battle Mountain and Winnemucca, Nevada. A total of 5 members of the public attended the Battle Mountain meeting on October 6, and 12 members of the public attended the Winnemucca meeting on October 7. Comments recorded during these meetings are available in the BLM's Winnemucca Field Office. Eight written comment letters were received by the BLM within the public comment period. One additional comment letter was received on December 18, 1998.

In addition to the EIS, implementing the proposed project or alternatives would require authorizing actions from other Federal, state, and local agencies with jurisdiction over certain aspects of the proposed project. Table 1-3 lists the required permits or approvals and the responsible regulatory agency.

## 1.7 Organization of the Environmental Impact Statement

This EIS follows the Council on Environmental Quality (CEQ) recommended organization (40 CFR 1508.9): Chapter 1.0 provides descriptions of the Proposed Action, relevant history of the project vicinity, purpose of and need for the Proposed Action, the environmental review process, applicable regulatory requirements and coordination, and organization of the EIS; Chapter 2.0 describes the Proposed Action and alternatives; Chapter 3.0 describes the affected environment, environmental consequences, cumulative impacts, mitigation and monitoring, and residual adverse impacts; Chapter 4.0 summarizes consultation and coordination for preparation of the EIS***, including comments and responses on the Draft EIS***; Chapter 5.0 presents the list of preparers and reviewers; and Chapter 6.0 is a list of references. Copies of supporting documents are on file in the BLM's Winnemucca Field Office and the BLM Nevada State Office in Reno.

**Table 1-2**
**Mining Claims Summary**

| Name Of Claim | BLM Serial Number | Owner | Owned/ Leased | Location |
|---|---|---|---|---|
| Bonz 1<br>Bonz 3<br>Bonz 5<br>Bonz 7<br>Bonz 9-18<br><br>Bonz 21-30<br><br>Rebonz 2<br>Rebonz 4<br>Rebonz 6<br>Rebonz 8<br>Rebonz 19-20<br><br>Rebonz 31<br>Rebonz 32 | 371610<br>371612<br>371614<br>371616<br>371618-<br>371627<br>371630-<br>371639<br>487422<br>487423<br>487424<br>487425<br>487426-<br>487427<br>487428<br>524363 | Roby Exploration Company | Owned | T33N, R42E, Sec. 12 |
| Mary 1-36[1] | 358968-<br>359003 | Roby Exploration Company | Owned | T33N, R43E, Sec. 4 |
| Mary 73-90<br><br>HS 123-134, 134A | 359040-<br>359057<br>400277-<br>400289 | Roby Exploration Company | Owned | T34N, R43E, Sec. 28 |
| Private | N/A | Newmont Gold Corporation | Leased | T33N, R43E, Sec. 5, 6, 7, 13, 25, 31 |
| Private | N/A | Newmont Gold Corporation | Leased | T34N, R43E, Sec. 13, 29, 31, 33 |
| *Recot 37[1]* | *NMC822614 - 822630* | *VEK/Andrus Associates* | *Leased* | *T33N, R43E, Sec. 8* |
| *Cot 38[1]* | *275733* | *VEK/Andrus Associates* | *Leased* | *T33N, R43E, Sec. 8* |
| *Recot 39–43[1]* | *NMC822614 - 822630* | *VEK/Andrus Associates* | *Leased* | *T33N, R43E, Sec. 8* |
| *Recot 45[1]* | *NMC822614 - 822630* | *VEK/Andrus Associates* | *Leased* | *T33N, R43E, Sec. 8* |
| *Recot 47[1]* | *NMC822614 - 822630* | *VEK/Andrus Associates* | *Leased* | *T33N, R43E, Sec. 8* |
| *Recot 50–54[1]* | *NMC822614 - 822630* | *VEK/Andrus Associates* | *Leased* | *T33N, R43E, Sec. 8* |
| *Cot 55–58[1]* | *275750 – 275753* | *VEK/Andrus Associates* | *Leased* | *T33N, R43E, Sec. 8* |
| *Recot 59[1]* | *NMC822614 - 822630* | *VEK/Andrus Associates* | *Leased* | *T33N, R43E, Sec. 8* |
| *Cot 60[1]* | *275755* | *VEK/Andrus Associates* | *Leased* | *T33N, R43E, Sec. 8* |
| *Recot 61[1]* | *NMC822614 - 822630* | *VEK/Andrus Associates* | *Leased* | *T33N, R43E, Sec. 8* |
| *Cot 62[1]* | *275757* | *VEK/Andrus Associates* | *Leased* | *T33N, R43E, Sec. 8* |
| *Recot 63A* | *NMC822614 - 822630* | *VEK/Andrus Associates* | *Leased* | *T33N, R43E, Sec. 8* |
| *Recot 63[1]* | *NMC822614 - 822630* | *VEK/Andrus Associates* | *Leased* | *T33N, R43E, Sec. 8* |
| *Cot 64–72[1]* | *275759 – 275767* | *VEK/Andrus Associates* | *Leased* | *T33N, R43E, Sec. 8* |
| *Cot Fractions 1–9* | *361164 – 361172* | *VEK/Andrus Associates* | *Leased* | *T33N, R43E, Sec. 8* |

**Table 1-2 (Continued)**

| Name Of Claim | BLM Serial Number | Owner | Owned/ Leased | Location |
|---|---|---|---|---|
| Cot 73-76<br><br>Cot 75A-76A | 3420680<br>37420671<br>3715590<br>371560 | VEK Andrus Associates | Leased | T32N, R43E, Sec. 6 |
| Cot 1-36 | 271972-<br>272007 | VEK/Andrus Associates | Leased | T33N, R42E, Sec. 36 |
| Private | N/A | Roby Exploration Company | Owned | T33N, R43E, Sec. 9 |
| Remary 237-272<br><br>Remary Fraction | 454876-<br>454911<br>552228 | Roby Exploration Company | Owned | T33N, R43E, Sec. 16 |
| Private | N/A | Roby Exploration Company | Owned | T33N, R43E, Sec. 17 |
| Red 1801A-1834A[1] | 678030-<br>678063 | Donald Decker and Suzanne Decker | Leased | T33N, R43E, Sec. 18 |
| Private | N/A | University of Nevada, Reno | Leased | T33N, R43E, Sec. 19 |
| Red 39-50[1]<br><br>Red 201-224[1] | 56187-56198<br>271665-<br>271668 | Donald Decker and Suzanne Decker | Leased | T33N,R43E, Sec. 20 |
| Red 21-38<br><br>Red 52-69<br><br>Red 23A and 24A | 48409-48426<br>56199-56216<br>552226-<br>552227 | Donald Decker and Suzanne Decker | Leased | T33N, R43E, Sec. 30 |
| Red 601-628 | 271689-<br>271716 | Donald Decker and Suzanne Decker | Leased | T33N, R43E, Sec. 6 |
| Kit 1-36 | 365642-<br>365677 | Donald Decker and Suzanne Decker | Leased | T33N, R42E, Sec. 24 |
| ***GMMCMS 55-69[2]*** | ***NMC822621-<br>822645*** | ***Donald Decker and Suzanne Decker*** | ***Leased*** | ***T33N, R43E, Sec. 18*** |
| ***GMMCMS 1-54[2]*** | ***NMC822560-<br>822613*** | ***VEK/Andrus Associates*** | ***Leased*** | ***T33N, R43E, Sec. 8*** |
| Private | N/A | Roby Exploration Company | Newmont Owned | T33N, R43E, Sec. 31 |
| Apri 1-13<br><br>Apri 14<br>Apri 15 | 371561-<br>371573<br>519580<br>552229 | Roby Exploration Company | Owned | T32N, R43E, Sec. 6 |
| Val 37-72 | 297572-<br>297607 | VEK/Andrus Associates | Leased | T34N, R43E, Sec. 30 |
| Val 237-262<br><br>Val 1013-1024 | 361136-<br>361161<br>600391-<br>600402 | Roby Exploration Company | Owned | T34N, R43E, Sec. 20 |
| Val 1-18<br><br>Val 19-31 | 297554-<br>297571<br>347463-<br>347475 | VEK/Andrus Associates | Leased | T34N, R43E, Sec. 32 |
| SAR 37-72 | 373649-<br>373684 | Euro-Nevada Mining Corporation, Inc. | Leased | T33N, R43E, Sec. 10 |
| Tyler 1-36 | 371574-<br>371609 | Roby Exploration Company | Owned | T34N, R42E, Sec. 36 |

***[1]Lode claims included in the comparison of the millsite to lode claim ratio (1:1) for existing and proposed operations. All of the lode claims within a lode claim grouping may not be included in this comparison.***
***[2]Millsite claims.***

N/A = Not applicable.

**Table 1-3**
**Major Permits and Approvals Required for the**
**Marigold Mine Expansion Project**

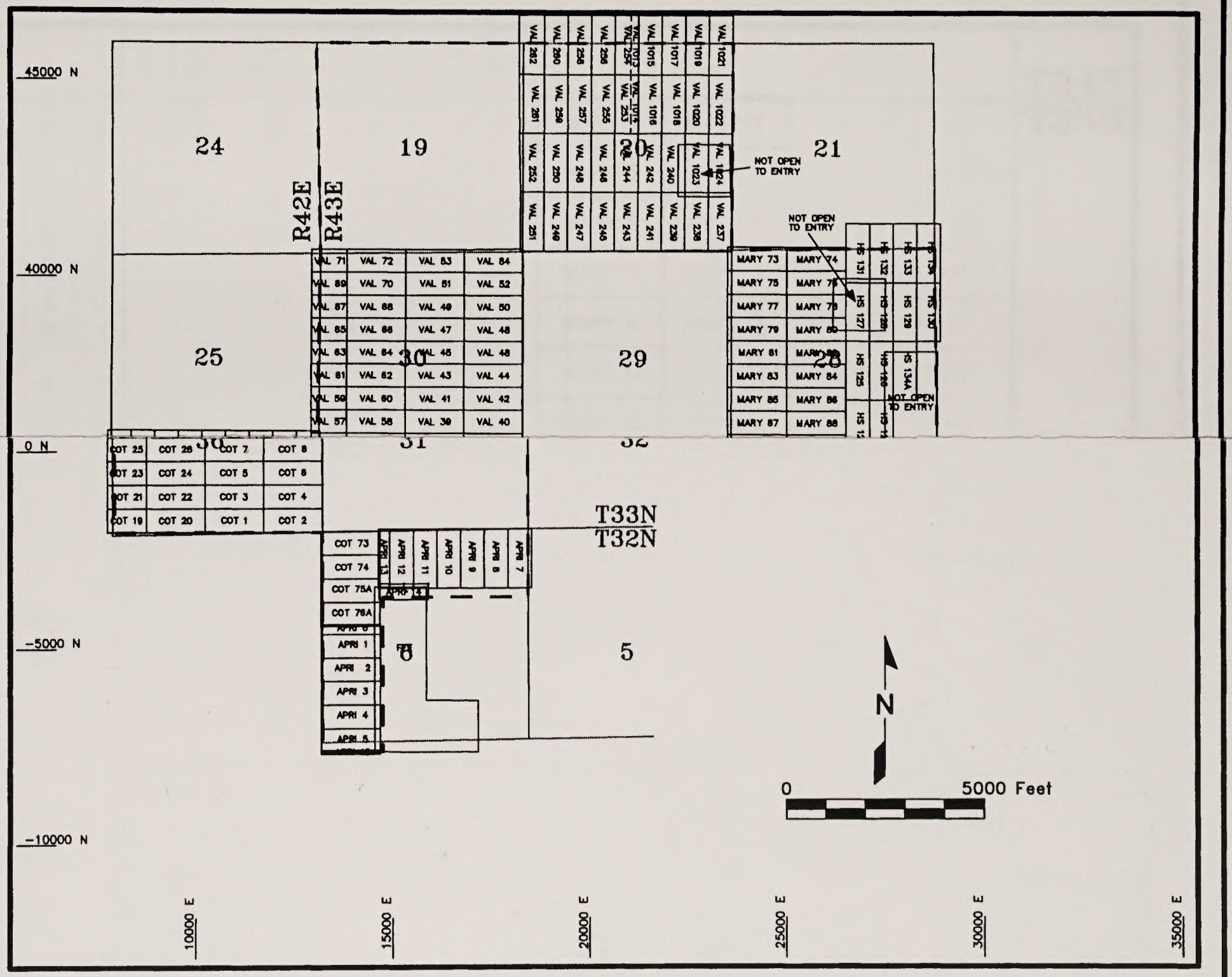
| Permit/Approval | Granting Agency |
|---|---|
| Approval of Plan of Operations, Rights-of-Way Permits | Bureau of Land Management |
| Clean Water Act Section 404 Permit | U.S. Army Corps of Engineers |
| Explosives Permit | Bureau of Alcohol, Tobacco, and Firearms |
| Air Quality Operating Permit | Nevada Department of Conservation and Natural Resources, Division of Environmental Protection, Bureau of Air Quality |
| Surface Disturbance Permit (Air Quality) | Nevada Department of Conservation and Natural Resources, Division of Environmental Protection, Bureau of Air Quality |
| Water Pollution Control Permit | Nevada Department of Conservation and Natural Resources, Division of Environmental Protection, Bureau of Mining Regulation and Reclamation |
| Reclamation Permit | Nevada Department of Conservation and Natural Resources, Division of Environmental Protection, Bureau of Mining Regulation and Reclamation |
| Permit to Appropriate Water and to Construct Impoundments | Nevada Department of Conservation and Natural Resources, Division of Water Resources |
| Industrial Artificial Pond Permits | Nevada Department of Conservation and Natural Resources, Division of Wildlife |
| Solid Waste Mining Site Class III Waiver | Nevada Department of Conservation and Natural Resources, Division of Environmental Protection, Bureau of Solid Waste |
| General Discharge Permit (Storm Water, Septic Systems) | Nevada Department of Conservation and Natural Resources, Division of Environmental Protection, Bureau of Water Pollution Control |
| Hazardous Materials Storage Permit | State of Nevada, Fire Marshal Division |
| EPA ID Number | U.S. Environmental Protection Agency |
| Liquefied Petroleum Gas License | Nevada Board for the Regulation of Liquefied Petroleum Gas |
| Radioactive Material License | Nevada State Health Division |
| Radio Station License | Federal Communications Commission |
| Special Use Permit | Humboldt County Regional Planning Commission |

LEGEND

— — PRIVATE LAND/PUBLIC LAND CLAIM BOUNDARY

[50] MILLSITE CLAIM

[COT 55] LODE CLAIM



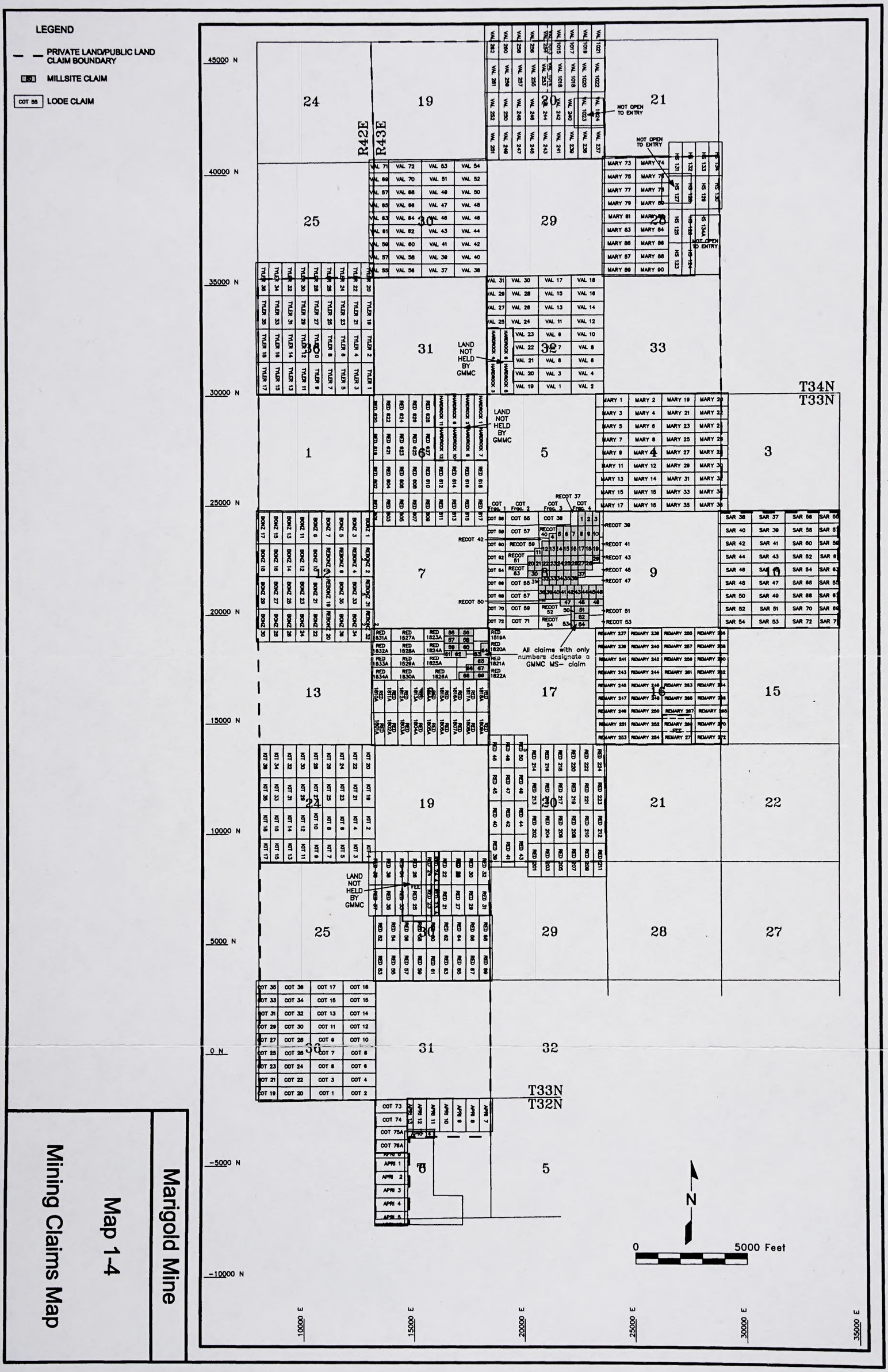

Marigold Mine

Map 1-4

Mining Claims Map

**Table 1-3**
**Major Permits and Approvals Required for the**
**Marigold Mine Expansion Project**

| Permit/Approval | Granting Agency |
|---|---|
| Approval of Plan of Operations, Rights-of-Way Permits | Bureau of Land Management |
| Clean Water Act Section 404 Permit | U.S. Army Corps of Engineers |
| Explosives Permit | Bureau of Alcohol, Tobacco, and Firearms |
| Air Quality Operating Permit | Nevada Department of Conservation and Natural Resources, Division of Environmental Protection, Bureau of Air Quality |
| Surface Disturbance Permit (Air Quality) | Nevada Department of Conservation and Natural Resources, Division of Environmental Protection, Bureau of Air Quality |
| Water Pollution Control Permit | Nevada Department of Conservation and Natural Resources, Division of Environmental Protection, Bureau of Mining Regulation and Reclamation |
| Reclamation Permit | Nevada Department of Conservation and Natural Resources, Division of Environmental Protection, Bureau of Mining Regulation and Reclamation |
| Permit to Appropriate Water and to Construct Impoundments | Nevada Department of Conservation and Natural Resources, Division of Water Resources |
| Industrial Artificial Pond Permits | Nevada Department of Conservation and Natural Resources, Division of Wildlife |
| Solid Waste Mining Site Class III Waiver | Nevada Department of Conservation and Natural Resources, Division of Environmental Protection, Bureau of Solid Waste |
| General Discharge Permit (Storm Water, Septic Systems) | Nevada Department of Conservation and Natural Resources, Division of Environmental Protection, Bureau of Water Pollution Control |
| Hazardous Materials Storage Permit | State of Nevada, Fire Marshal Division |
| EPA ID Number | U.S. Environmental Protection Agency |
| Liquefied Petroleum Gas License | Nevada Board for the Regulation of Liquefied Petroleum Gas |
| Radioactive Material License | Nevada State Health Division |
| Radio Station License | Federal Communications Commission |
| Special Use Permit | Humboldt County Regional Planning Commission |

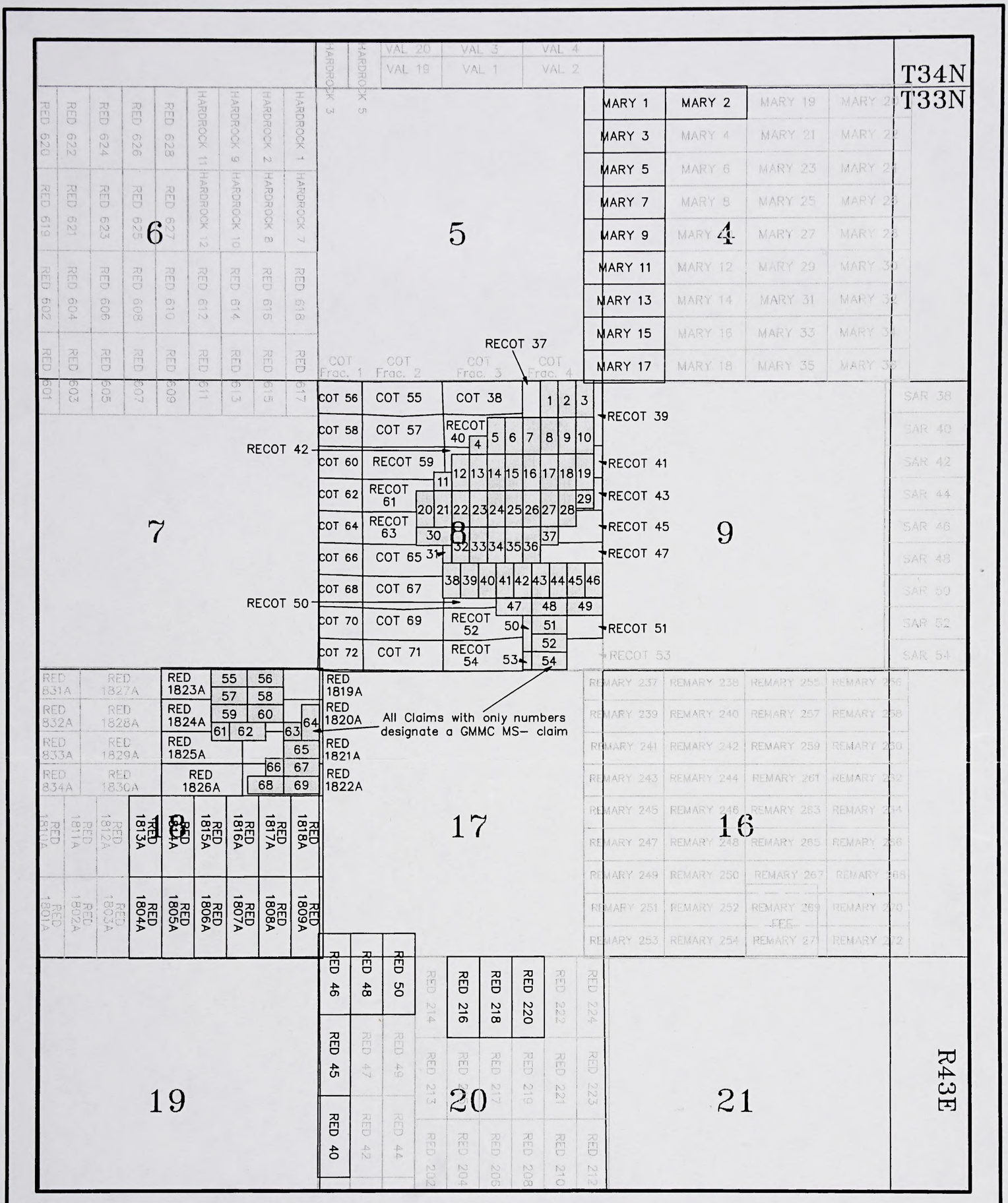



Marigold Mine

Map 1-4

Mining Claims Map

| | | |




## LEGEND

50 MILLSITE CLAIM

COT 55 LODE CLAIM

N

0 3000 Feet

**Note:** Claims in bold indicate claims that have been affected by existing operations and would be affected by proposed operations.

**Marigold Mine**

**Map 1-5**

**Millsite and Lode Claims Affected by Existing and Proposed Operations**



# 2.0 PROPOSED ACTION

## 2.1 Introduction

Glamis Gold, Inc./Rayrock Mines, Inc., doing business as Glamis Marigold Mining Company (GMMC), currently operates the Marigold Mine under the existing Plan of Operations/Reclamation Plan (POO/RP) No. N26-88-005P, amended July 3, 1997, and May 27, 1998; the Nevada Division of Environmental Protection (NDEP) Reclamation Permit No. 0108; and Water Pollution Control Permit NEV88040. GMMC proposes to expand the current mining operation at the Marigold Mine. The POO Amendment and RP (MMC 1998) for the GMMC Expansion Project has previously been submitted to the Bureau of Land Management (BLM) - Winnemucca Field Office and the NDEP - Bureau of Mining Regulation and Reclamation. The amended plan would comply with the BLM regulations for surface mining of public land under the General Mining Law (43 CFR 3809), and the State of Nevada regulations for reclamation of land subject to mining operations under Nevada Revised Statutes (NRS 445 and 519A).

## 2.2 Proposed Action

The Marigold Mine is located on the northwestern flank of Battle Mountain (Township 33 North [T33N], Range 43 East [R43E], Sections 5, 7, 8, 9, 16, 17, 18, 19, 20, and 32; T34N, R43E, Section 32), approximately 3 miles south of the town of Valmy, Nevada, at elevations ranging between 4,600 and 5,800 feet above mean sea level (amsl) (Map 1-2). The mine has been in commercial operation since 1988.

***GMMC owns approximately 8,320 acres of land and controls the majority of mining claims on public-administered land (10,480 acres) in the project vicinity*** (Map 2-1). Existing operations (described in Section 1.2) comprise approximately 1,349 disturbance acres, of which approximately 711 acres are located on public land administered by the BLM, and approximately 638 acres are on private land (see Table 2-1). There is no State of Nevada-administered property within the project area of operations. However, there is private land owned by the University of Nevada, Reno, a state institution. Surface disturbance of that land is included in the private land category.

The proposed Marigold Mine Expansion Project would disturb approximately 462 acres of private land and 255 acres of BLM-administered public land, for a total of 717 acres (see Table 2-2). The proposed project would include expansion of two pits and development of two new pits; expansion of two waste rock dumps and development of two new waste rock dumps; addition of lifts to three existing heap leach cells, addition of one cell to an existing leach pad, and development of a new heap leach facility; expansion of the existing tailings impoundment; and construction of a second tailings impoundment; construction of haul roads, solution ponds, growth media stockpiles, exploration drill pads and access roads, diversion channels; and realignment of a public access road (Buffalo Valley Road) and power line. The Proposed Action would extend the mine operations a maximum of 5 years through ***2007***.

This proposed disturbance represents the ultimate footprint of each facility based on $400/ounce gold. However, all pits, except the proposed 8-North Pit, have reserves that can be economically recovered at less than $400/ounce gold prices. Therefore, the actual disturbance for all of the facilities is likely to be less than proposed unless gold prices rebound, as the 134 acres associated with the proposed 8-North Pit and waste rock dump would not be feasible with gold prices below $400/ounce.

A summary of the existing and proposed surface disturbance is presented in Tables 2-1 and 2-2, respectively. The layout of the existing facilities is illustrated in Map 1-3. Surface ownership is presented in Map 2-1, and the layout of proposed facilities is illustrated in Map 2-2.

**Table 2-1**
**Acres of Existing Permitted Disturbance**

| Facility | Public Land | Private Land | Total |
|---|---|---|---|
| Pits | 272 | 132 | 404 |
| Waste Rock Dumps | 292 | 148 | 440 |
| Heap Leach Pads | 56 | 74 | 130 |
| Crushing/Mill/Plant Facilities | 35 | 17 | 52 |
| Tailings Impoundment | 0 | 180 | 180 |
| Process Ponds | 5 | 0 | 5 |
| Storm Water Ponds | 1.5 | 1.5 | 3 |
| Growth Media Stockpiles | 5 | 15 | 20 |
| Haul Roads/Access Roads | 22 | 38 | 60 |
| Water Supply System | 4 | 9 | 13 |
| Diversion Ditches/Creek Diversions | ~0.1 | 3 | 3 |
| Exploration Drill Pads and Roads | 17 | 20 | 37 |
| "Infill"/Miscellaneous Areas | 1.5 | 0.5 | 2 |
| Total Disturbance | 711 | 638 | 1,349 |

**Table 2-2**
**Estimated Acres of New Disturbance Under the Proposed Action**

| Facility | Public Land | Private Land | Total |
|---|---|---|---|
| Pits | 52 | 79 | 131 |
| Waste Rock Dumps | 120 | 164 | 284 |
| Heap Leach Pads | 0 | 78 | 78 |
| Crushing/Milling/Plant Facilities | 0 | 1 | 1 |
| Tailings Impoundment | 0 | 54 | 54 |
| Process Ponds | 0 | 2 | 2 |
| Storm Water Ponds | 0 | 3 | 3 |
| Growth Media Stockpile | 5 | 23 | 28 |
| Haul Roads/Access Roads | 14 | 14 | 28 |
| Diversion Ditches/Creek Diversions | 14 | 17 | 31[1] |
| Exploration Drill Pads and Roads[2] | 0 | 5 | 5 |
| "Infill"/Miscellaneous Areas | 50 | 22 | 72 |
| Total Disturbance | 255 | 462 | 717 |

[1]Total acreage is based on the following: 5N Cottonwood Creek – 10 acres; SW Heap Diversion – 13 acres; and 8N Trout Creek – 8 acres.
[2]Exploration disturbance locations have not yet been precisely determined, but the majority is anticipated to occur on private land.

LEGEND

PRIVATE LAND/PUBLIC LAND CLAIM BOUNDARY

CURRENT PERMIT BOUNDARY

PROPOSED PERMIT BOUNDARY

LAND STATUS

LANDS ADMINISTERED BY BLM

PRIVATE LANDS

(UNIVERSITY OF NEVADA, RENO) LANDS




Marigold Mine

Map 2-1

Surface Ownership

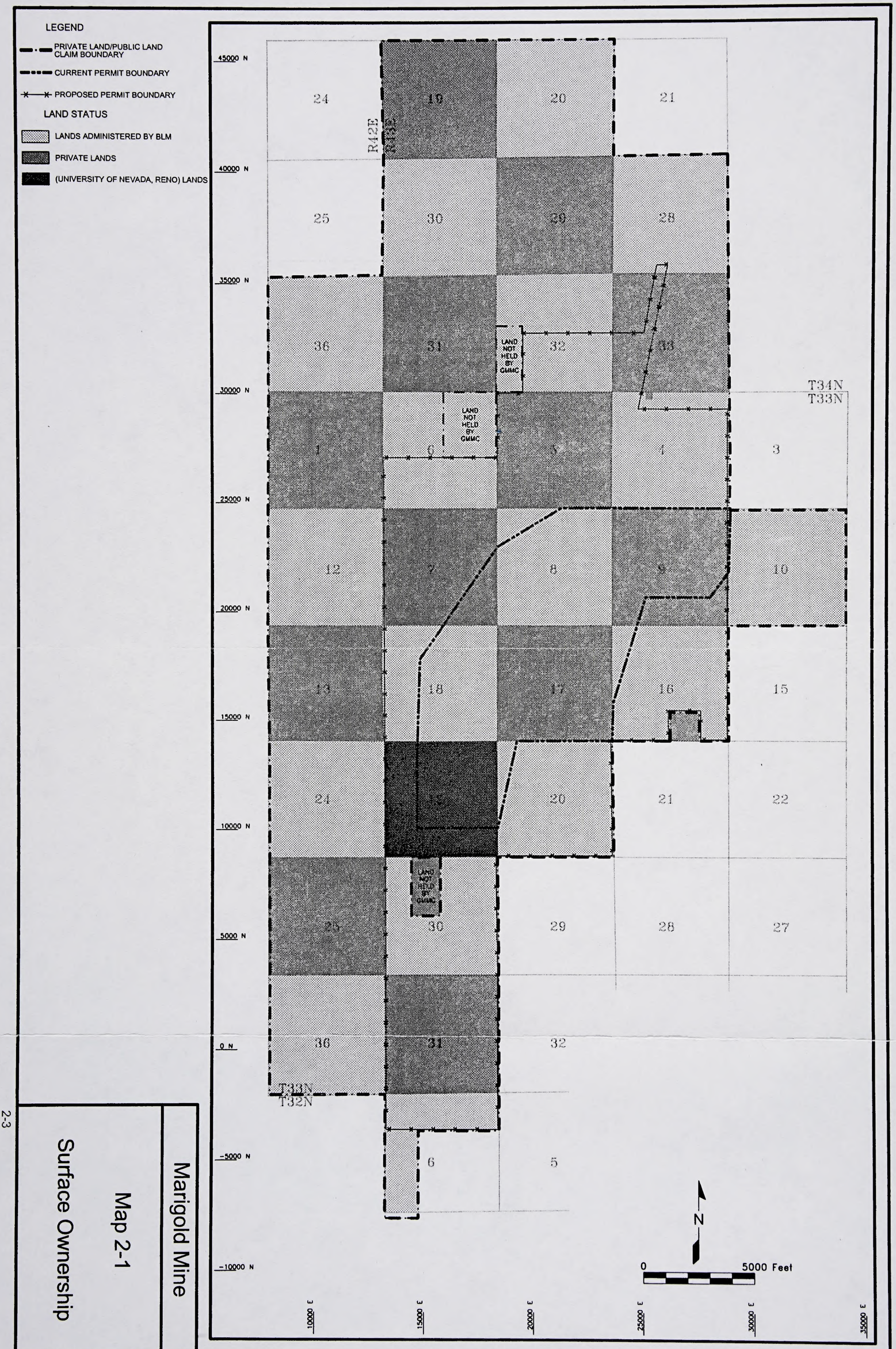
**Table 2-1**
**Acres of Existing Permitted Disturbance**

| Facility | Public Land | Private Land | Total |
|---|---|---|---|
| Pits | 272 | 132 | 404 |
| Waste Rock Dumps | 292 | 148 | 440 |
| Heap Leach Pads | 56 | 74 | 130 |
| Crushing/Mill/Plant Facilities | 35 | 17 | 52 |
| Tailings Impoundment | 0 | 180 | 180 |
| Process Ponds | 5 | 0 | 5 |
| Storm Water Ponds | 1.5 | 1.5 | 3 |
| Growth Media Stockpiles | 5 | 15 | 20 |
| Haul Roads/Access Roads | 22 | 38 | 60 |
| Water Supply System | 4 | 9 | 13 |
| Diversion Ditches/Creek Diversions | ~0.1 | 3 | 3 |
| Exploration Drill Pads and Roads | 17 | 20 | 37 |
| "Infill"/Miscellaneous Areas | 1.5 | 0.5 | 2 |
| Total Disturbance | 711 | 638 | 1,349 |

**Table 2-2**
**Estimated Acres of New Disturbance Under the Proposed Action**

| Facility | Public Land | Private Land | Total |
|---|---|---|---|
| Pits | 52 | 79 | 131 |
| Waste Rock Dumps | 120 | 164 | 284 |
| Heap Leach Pads | 0 | 78 | 78 |
| Crushing/Milling/Plant Facilities | 0 | 1 | 1 |
| Tailings Impoundment | 0 | 54 | 54 |
| Process Ponds | 0 | 2 | 2 |
| Storm Water Ponds | 0 | 3 | 3 |
| Growth Media Stockpile | 5 | 23 | 28 |
| Haul Roads/Access Roads | 14 | 14 | 28 |
| Diversion Ditches/Creek Diversions | 14 | 17 | 31[1] |
| Exploration Drill Pads and Roads[2] | 0 | 5 | 5 |
| "Infill"/Miscellaneous Areas | 50 | 22 | 72 |
| Total Disturbance | 255 | 462 | 717 |

[1]Total acreage is based on the following: 5N Cottonwood Creek – 10 acres; SW Heap Diversion – 13 acres; and 8N Trout Creek – 8 acres.
[2]Exploration disturbance locations have not yet been precisely determined, but the majority is anticipated to occur on private land.



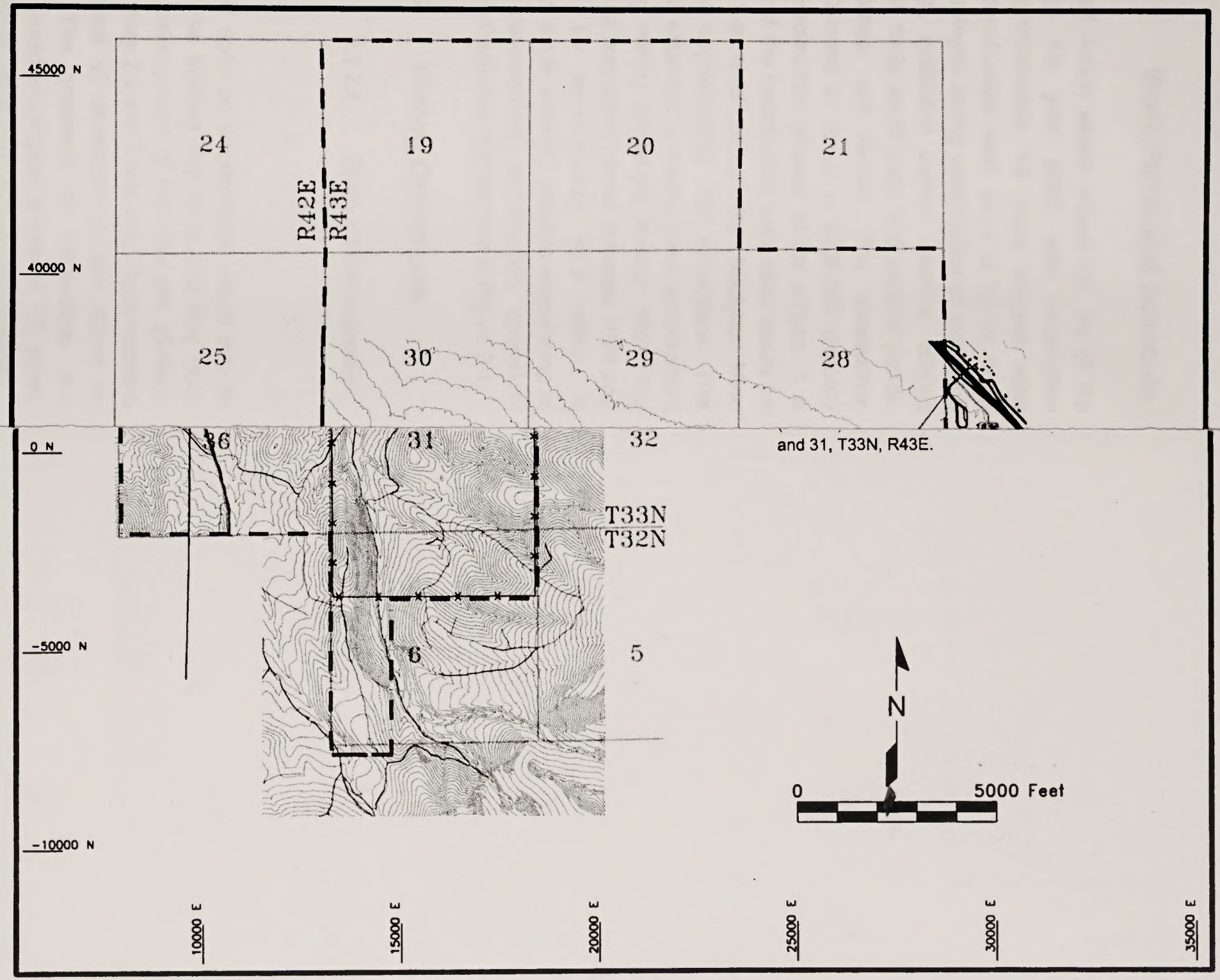

Marigold Mine

Map 2-1

Surface Ownership

LEGEND

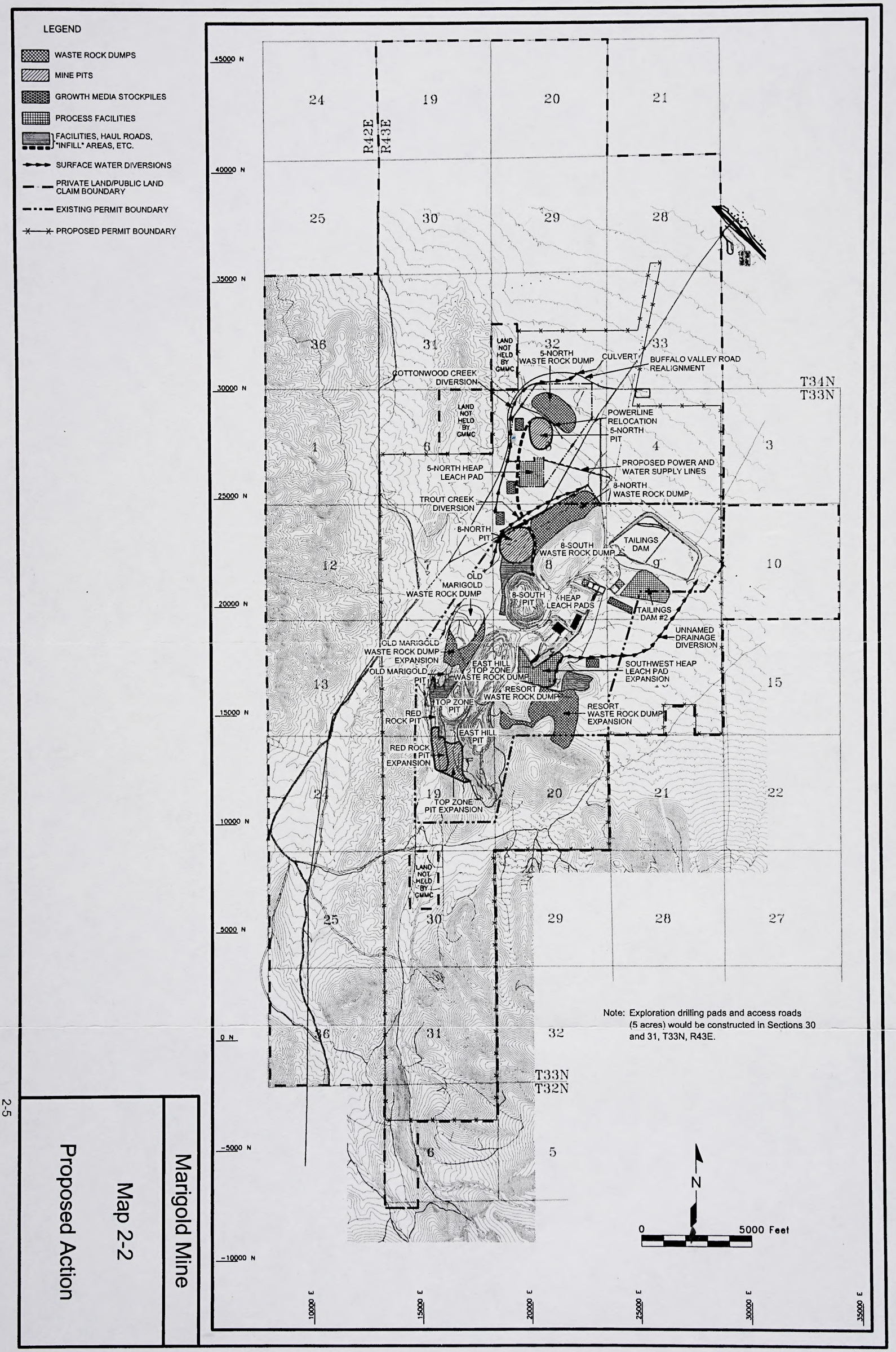
- WASTE ROCK DUMPS
- MINE PITS
- GROWTH MEDIA STOCKPILES
- PROCESS FACILITIES
- FACILITIES, HAUL ROADS, "INFILL" AREAS, ETC.
- SURFACE WATER DIVERSIONS
- PRIVATE LAND/PUBLIC LAND CLAIM BOUNDARY
- EXISTING PERMIT BOUNDARY
- PROPOSED PERMIT BOUNDARY




Marigold Mine

Map 2-2

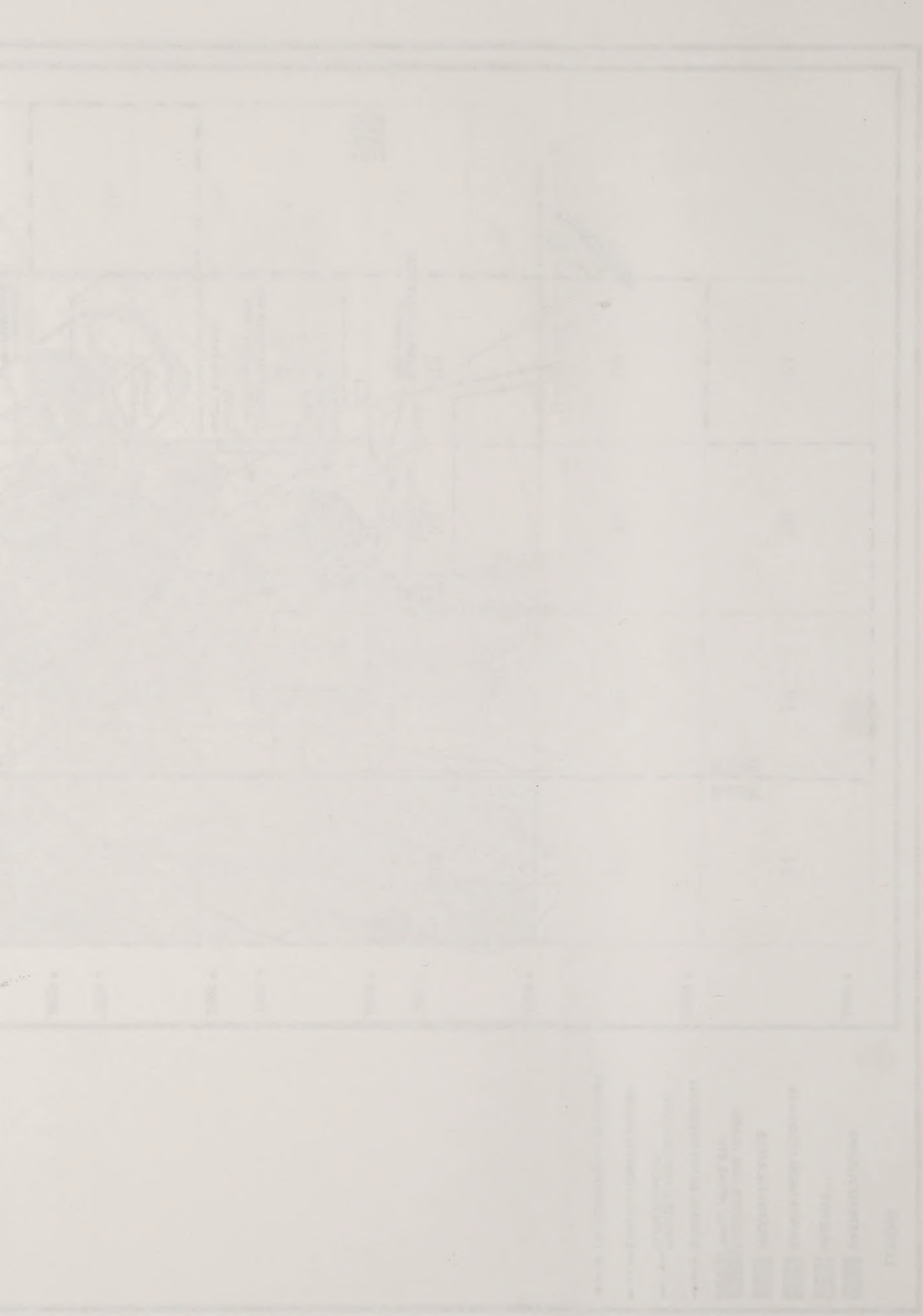
Proposed Action




Marigold Mine

Map 2-2

Proposed Action



### 2.2.1 Work Force and Schedule

The Proposed Action would extend the life of the mine through the year ***2007***, with reclamation extending approximately 10 years beyond mine closure. A construction work force of 30 or fewer would be employed during construction of expanded facilities (e.g., additional carbon columns, tailings impoundment, heap leach pads and solution ponds, diversion ditches, and fences). The construction payroll is estimated to be up to $288,000 annually during the construction phases of the project. It is anticipated that the construction work force would be hired from the local areas. The Marigold Mine currently has approximately ***100*** employees. This number is not expected to exceed peak employment of 113 during mining operations through ***2007***. The average annual operations payroll between 1999 and ***2007*** would be approximately $4.5 million. A conceptual schedule showing possible sequencing of principal pre-development, construction, operation, and reclamation activities is presented in Figure 2-1.

### 2.2.2 Mining Operations

#### 2.2.2.1 Open Pit Development

**Open Pits**

The proposed open pit development would include expansion of the existing Top Zone and Red Rock pits and the development of two new pits (5-North and 8-North) (Map 2-2 and Table 2-2). Cross sections of the proposed pit developments are shown on Figure 2-2. The proposed pit expansions and development would encompass a total of 131 acres. Pit benches would range from 20 to 40 feet in width.

The Top Zone Pit would be expanded 29 acres to the south. The final dimensions and depth of the pit would be approximately 4,770 feet long, 1,100 feet wide, and 760 feet deep. The Top Zone Pit expansion would deepen the existing pit by approximately 60 feet to a final pit floor elevation of 4,740 feet (amsl). The Red Rock Pit would be expanded 24 acres to the south. The final pit configuration would be approximately 1,400 feet long, 800 feet wide, and 420 feet deep. The Red Rock Pit expansion would deepen the existing pit by 120 feet to a final pit floor elevation of 4,980 feet (amsl). ***Gold can be economically recovered from the Top Zone and Red Rock pits at the current gold prices (approximately $300 per ounce).***

Development of the proposed 5-North Pit would result in a surface disturbance of 29 acres. The pit would be located approximately 0.5 mile north of the existing operation. The maximum pit dimensions and depth would be approximately 1,500 feet long, 850 feet wide, and 280 feet deep, with a final pit floor elevation of 4,450 feet (amsl). ***The development of the 5-North Pit would be dependent on gold prices being at or above $350 per ounce.*** The proposed 8-North Pit would be located just north of the existing 8-South Pit and would result in a surface disturbance of 49 acres. The proposed pit would have maximum dimensions of 1,940 feet long, 1,900 feet wide, and 420 feet deep. The final pit floor elevation would be approximately 4,480 feet (amsl). The development of the 8-North Pit would be dependent on gold prices being at or above $400 per ounce.

Drilling and blasting procedures currently implemented for pit development at GMMC's existing operation also would be utilized for pit development under the Proposed Action. Ore and waste rock would be drilled on approximately 14-foot centers using diesel-powered rotary hammer drills. The drill holes would be charged with an ammonium nitrate/fuel oil mixture by means of a truck-mounted mixing/dispensing unit. Blasting would occur during the daylight hours and would be in compliance with applicable safety standards. Usually, one blast would occur each day at mid-day or late afternoon. Material would be mined on 20- to 40-foot benches. Unconsolidated gravels and growth media that do not require drilling and blasting would be ripped with a dozer, as required, for removal. Slope angles in the open pits would range from 34 to 55 degrees depending on the pit and specific locations within the pit.

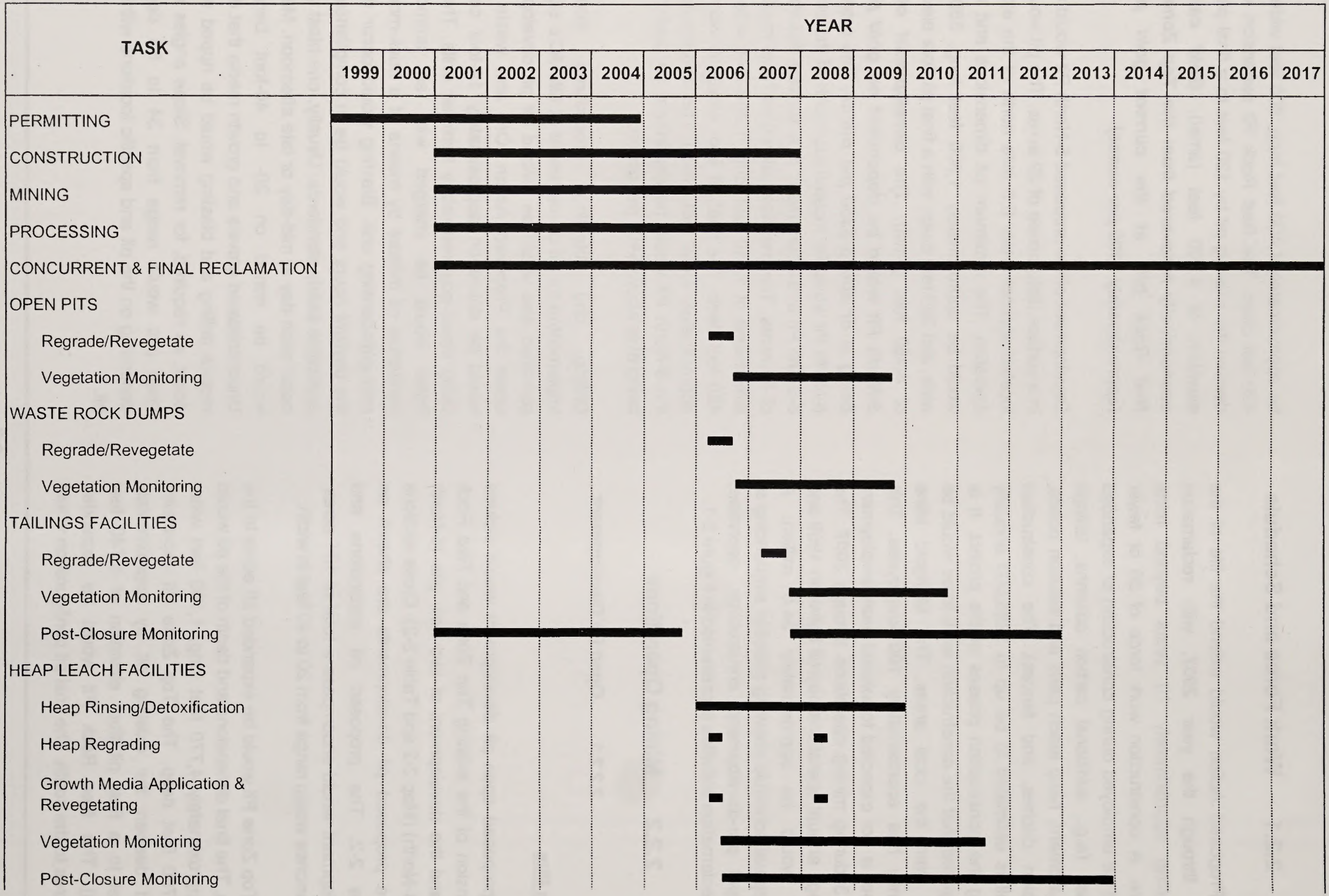





**Figure 2-1. Project Schedule**

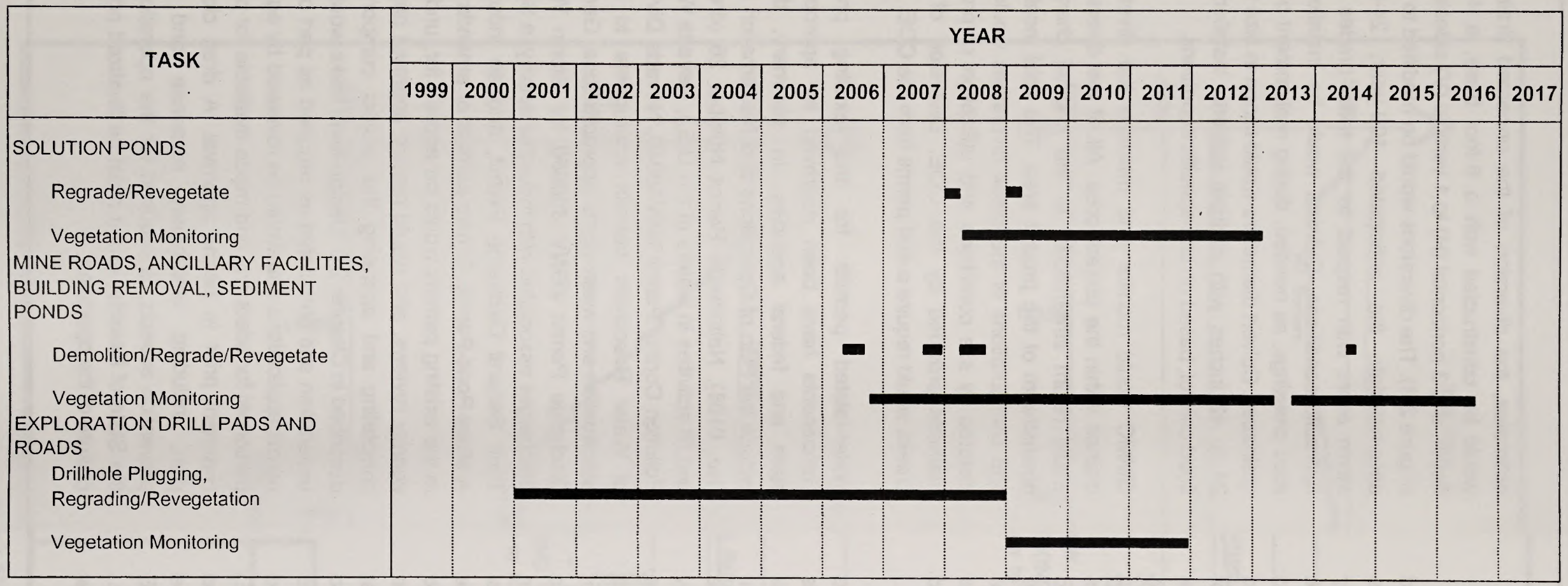



Figure 2-1. Project Schedule

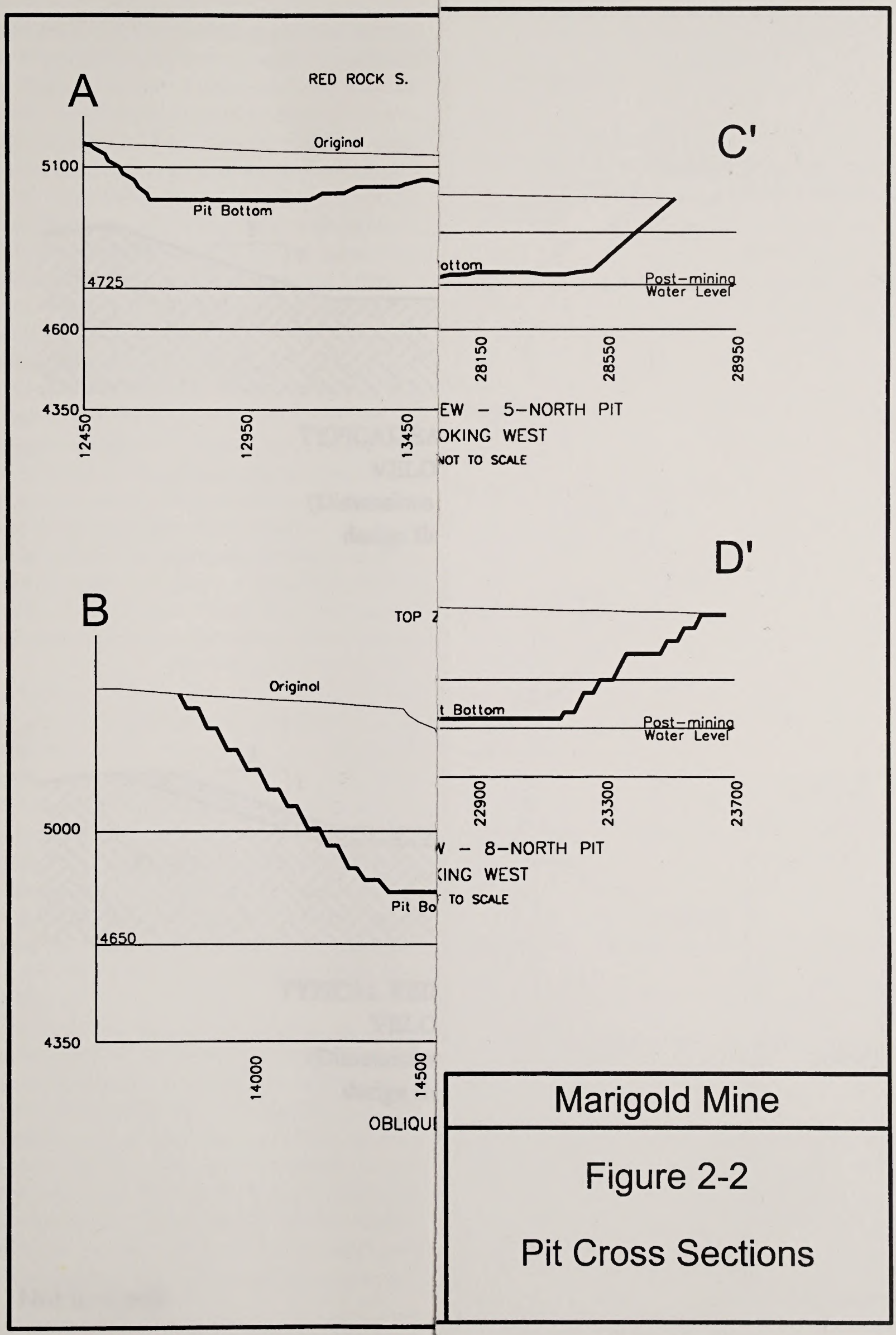
#### 2.2.2.2 Surface Water Diversions

Diversions of Trout Creek, Cottonwood Creek, and one unnamed drainage would be required under the Proposed Action. Trout Creek, which was previously diverted during development of the existing Red Rock (North), and 8-South pits, would be rediverted to facilitate development of the proposed 8-North Pit and Waste Rock Dump. The proposed diversion of Cottonwood Creek would allow development of the proposed 5-North Pit and Waste Rock Dump. To facilitate the construction of the proposed Southwest Heap Leach Pad expansion and Tailings Impoundment (Tailing Dam #2), one of the two unnamed drainages in the project area would be diverted. The other unnamed drainage would be protected from mine run-off by the topography of the area and its relationship to existing and proposed facilities (Map 2-2).

The Cottonwood Creek, Trout Creek, and unnamed drainage diversions would extend across grades ranging from 1 to 8 percent. The Trout Creek diversion would be 6,300 feet in length. Approximately 2,255 feet of the existing drainage channel would be disturbed, and approximately 3,690 feet of the existing diversion channel would be realigned. The Cottonwood Creek diversion would be approximately 8,050 feet in length. The diversion of the unnamed drainage around the Southwest Heap Leach Pad expansion and Tailings Impoundment would be up to approximately 9,300 feet long. Total acreage of new disturbance associated with these diversions would be approximately 31 acres. The diversions would generally have a trapezoidal shape and armored riprap along alignments with flows that exceed a velocity of 4 feet per second. Prior to construction, the actual design criteria for the diversion structures would be developed and submitted to the U.S. Army Corps of Engineers (COE) for approval according to the mine plan schedule. The D50 (i.e., average diameter) for the riprap would be based on the design criteria as specified by the COE for each sub-basin and for the appropriate event (e.g., 100-year storm, etc.). Based on preliminary flow estimates, the diversion of the unnamed drainage would be constructed with a 6-foot base, a 4-foot depth, and 3 horizontal (H) to 1 vertical (V) sideslopes (Figure 2-3). The diversions would be modified to best accommodate the anticipated 100-year, 24-hour storm event with respect to the local grades and hydraulic conditions. Culverts would be installed at road crossings, as needed, during realignment of the drainages. Culvert diameters would range in size from 24 to 42 inches with multiple culverts installed for flood control, based on site-specific conditions.

GMMC would monitor and maintain the diversion ditches within the project area. All of the diversions would return streamflows to the original channels downstream of the project area. The final locations and configurations of the creek diversions would be dictated by site conditions and utilization of proven methods provided by the COE. Diversion of the creeks would require a 404 permit from the COE.

Water-related permits for the existing project components have been approved by appropriate state and federal agencies. In summary, these include the Plan of Operations and Reclamation Plan (No. 0108), Nationwide Permit Number 26 (dredge and fill activities in waters of the U.S.), Nevada Water Pollution Control Permit NEV88040, Nevada Division of Water Resources permits appropriate to dam construction and water rights appropriations, General Discharge Permit ***#GNV 300000*** for Storm Water Discharges associated with industrial activity, a Septic Tank General Discharge Permit, and an Industrial Artificial Pond Permit. Similar permits or amendments to the existing permits would be applied for, undergo agency reviews, and would require approval prior to completing and operating the project components described in Chapter 2.0. Design-level tasks would be undertaken and completed as required as part of the permit applications and would be reviewed by agency personnel for adequacy and made available for public comment prior to permit approval. A draft closure plan, including emergency response and spill prevention aspects, is required for the operation by the State of Nevada, and it must be finalized prior to closure of the operation.




# Marigold Mine

## Figure 2-2

## Pit Cross Sections

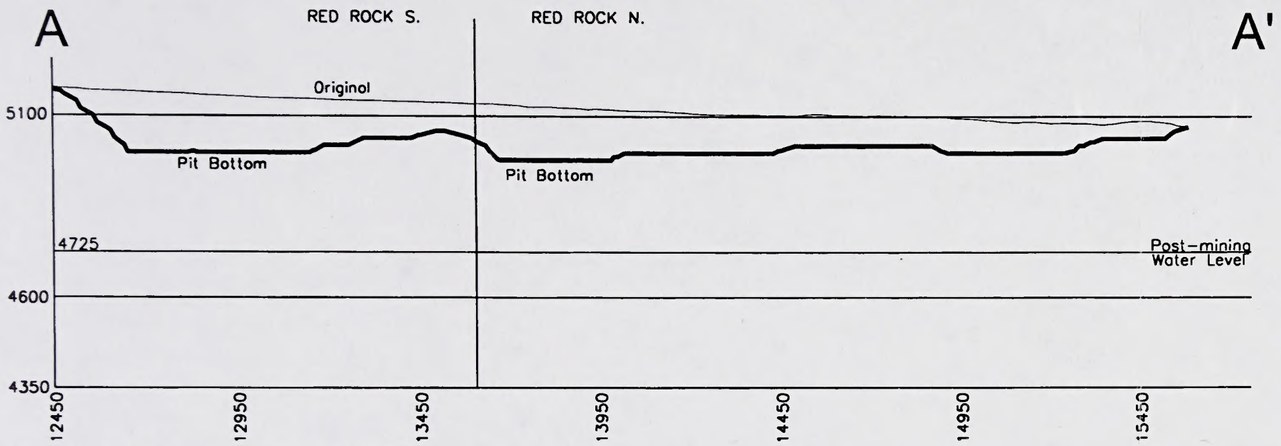
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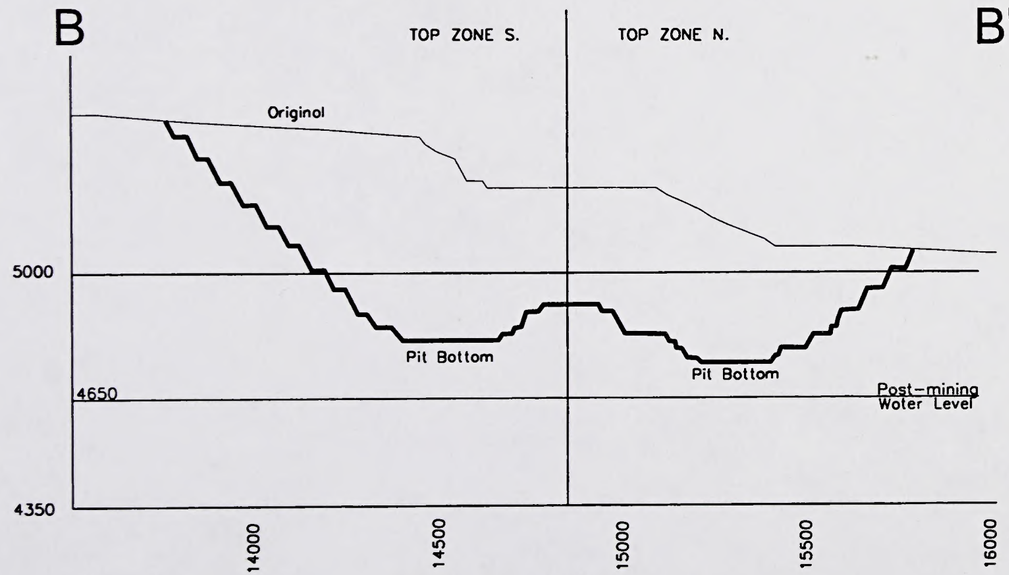
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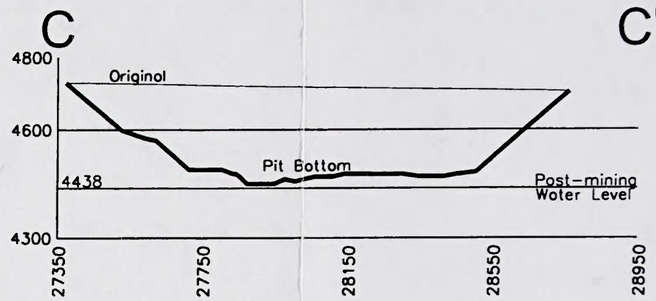
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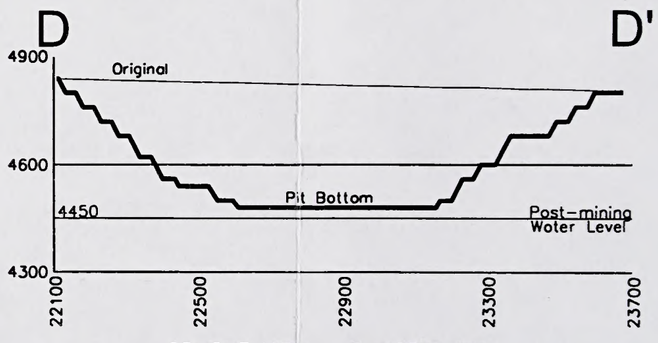

OBLIQUE SECTION – RED ROCK PIT
LOOKING WEST
NOT TO SCALE




OBLIQUE VIEW – TOP ZONE PIT
LOOKING WEST
NOT TO SCALE

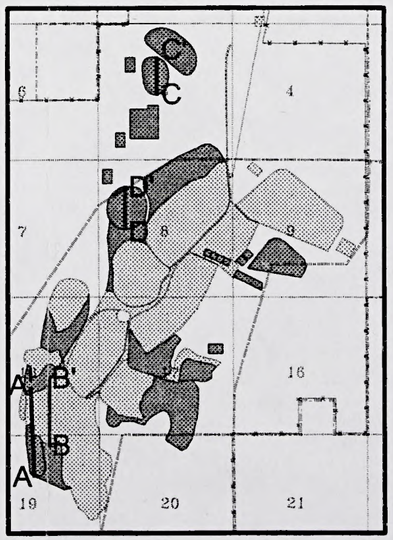



OBLIQUE VIEW – 5-NORTH PIT
LOOKING WEST
NOT TO SCALE




OBLIQUE VIEW – 8-NORTH PIT
LOOKING WEST
NOT TO SCALE

## Location Map

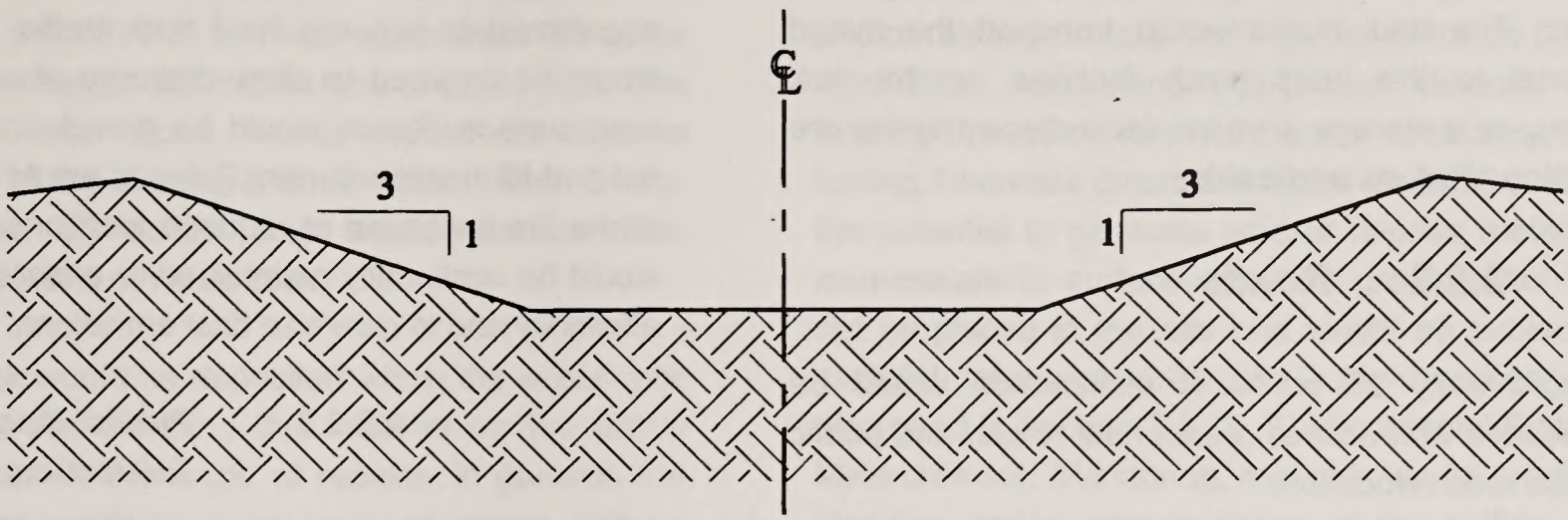



# Marigold Mine

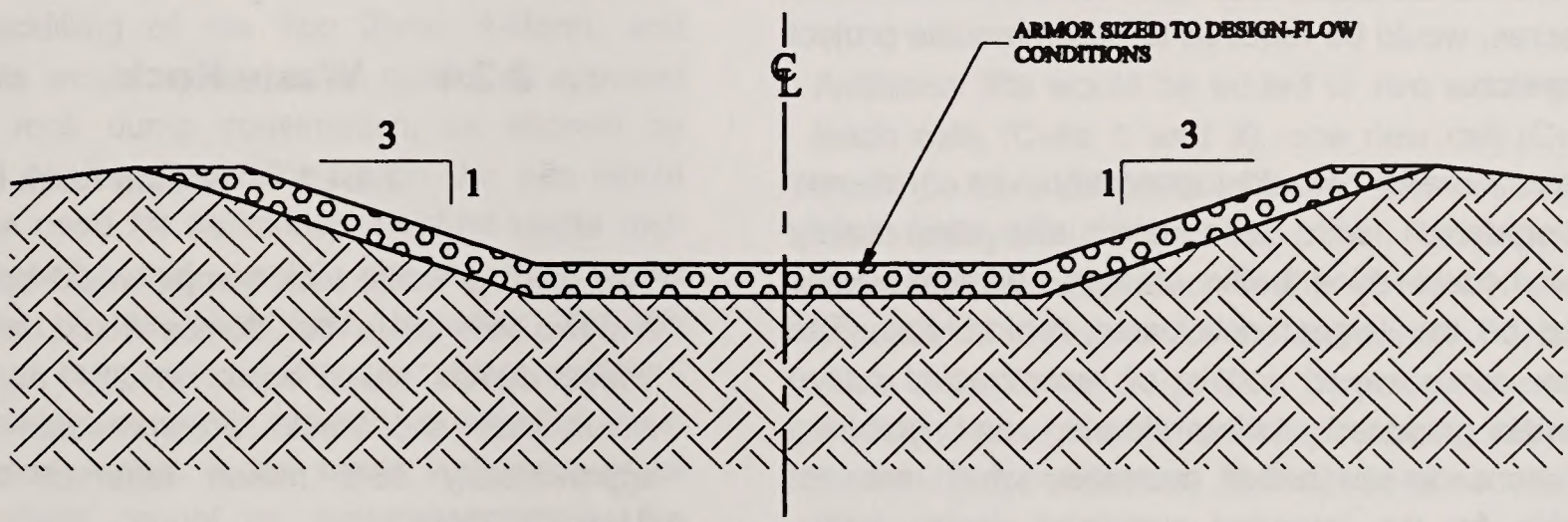
## Figure 2-2

## Pit Cross Sections






**TYPICAL EARTHEN CHANNEL**
**VELOCITY < 4 FT/S**
**(Dimensions to accommodate the design flow plus freeboard)**




**TYPICAL REINFORCED CHANNEL**
**VELOCITY > 4 FT/S**
**(Dimensions to accommodate the design flow plus freeboard)**

Not to scale

Marigold Mine

Figure 2-3

Typical Creek Diversion Cross Sections

#### 2.2.2.3 Loading and Hauling

Blasted ore and waste rock would be loaded by hydraulic loader onto 85- to 90-ton capacity haul trucks. The haul trucks would transport the mined material to the heap leach facilities, waste rock dumps, or a storage area located adjacent to the ore crushing plant, as applicable.

### 2.2.3 Roads

Approximately 28 acres of disturbance would be associated with access roads, haul roads, and public access road relocation.

#### 2.2.3.1 Access Roads

Access roads would be constructed for the proposed tailings impoundment, 5-North Pit, 8-North Pit, Resort Waste Rock Dump expansion, any additional appurtenant structures and facilities necessary for operation of the site, and to allow the continuation of exploration activities. Approximately 1 mile of access roads, with an associated new land disturbance of 3.5 acres, would be required to accommodate project expansion.

Access roads would generally be two-way thoroughfares with adequate size to safely accommodate mine traffic utilizing optimum widths based on the largest anticipated vehicle size. The access roads would consist of recompacted native materials exposed during clearing and grubbing operations. In-situ native materials, which are not suitable for the intended sustained design traffic, would be augmented with suitable on-site native materials to enhance road-bed performance.

#### 2.2.3.2 Haul Roads

Approximately 1.3 miles of haul roads, with an associated 11.8 acres of new disturbance, would be constructed to connect the proposed 5-North and 8-North pits with existing and proposed waste rock dumps and ore processing facilities (Map 2-2). Haul roads would be constructed in conformance with Mine Safety and Health Administration (MSHA) regulations. Traffic direction signs (i.e., right-hand and left-hand traffic) would be posted for all haul roads. In general, haul roads would be approximately 75 feet wide to accommodate two-way haul truck traffic. Haul roads would be crowned to allow drainage of water off the road surface. Roads would be graveled, with limited cut-and-fill in steep terrain. Culverts would be installed under the haul road at required locations. The roads would be continually maintained to ensure safety and efficiency and to minimize dust emissions.

#### 2.2.3.3 Public Access Road Relocation

One public access road (i.e., Buffalo Valley Road), which crosses the project area near the proposed 5-North and 8-North pits, would be realigned to facilitate development and construction of the proposed project expansion (Map 2-2). This 2.1-mile realignment would be 50 feet wide and have an associated land disturbance of 12.7 acres. Road construction would be in accordance with applicable county permit requirements.

### 2.2.4 Waste Rock

#### 2.2.4.1 Waste Rock Dumps

Two existing waste rock dumps would be expanded, and two new waste rock dumps would be developed. These dumps would result in 284 acres of new disturbance and would accommodate a total of approximately 56.5 million tons of waste rock (Map 2-2, Table 2-2).

The two existing waste rock dumps proposed for expansion include the Old Marigold Waste Rock Dump and the Resort Waste Rock Dump. The currently approved 55-acre Old Marigold Waste Rock Dump would be expanded to the south by an additional 41 acres and would accommodate 15 million tons of waste rock. The existing 70-acre Resort Waste Rock Dump would be expanded 103 acres to the east and would accommodate approximately 16.7 million tons of waste rock.

The two new waste rock dumps include the 5-North Waste Rock Dump and the 8-North Waste Rock Dump. The proposed 5-North Waste Rock Dump would be located to the north-northeast of the proposed 5-North Pit. It would encompass 55 acres and accommodate 8.3 million tons of waste rock. The 8-North Waste Rock Dump would be located northwest of the existing 8-South Waste Rock Dump, encompass 85 acres, and would accommodate 16.5 million tons of waste rock.

Waste rock would be deposited within the waste rock dumps by end-dumping the material on the active bench faces at the angle of repose. In general, the dump faces would be at the angle of repose, with an average bench height of approximately 40 feet. The 8-North Waste Rock Dump would be constructed with 50- to 60-foot lifts. Progressive lifts would be constructed in a similar manner with a sufficient setback to provide an overall slope of 3H:1V to allow for decommissioning and final reclamation.

#### 2.2.4.2 Pit Backfill

Partial backfilling of the Top Zone, 8-North, and 5-North pits would remain as an option, as opposed to waste rock dump construction, as allowed by sequential mining. Backfilling within the pits would reduce the need for additional out-of-pit waste rock dump capacity and would provide for partial reclamation of the open pits. However, for the purposes of this analysis and permitting, sufficient surface waste rock dump capacity is provided for in the Proposed Action, in the event that some or all backfill options cannot be accommodated by the mining sequence.

The proposed partial backfilling of the Red Rock Pit (South) would provide more efficient access during mining and would ensure the stability of the west high wall and the proposed Trout Creek diversion required for pit development. The final dimensions of the proposed Red Rock Pit backfill along the west wall would be approximately 50 feet high, 200 feet wide, and 600 feet long, and would accommodate approximately 530,000 tons of waste rock.

To ensure that the overburden used to backfill any of the pits does not have the ability to degrade waters of the state, any material to be placed in the pits would be characterized for its potential to generate acid and/or release metals. Testing would include both the Acid Base Accounting (ABA) and Meteoric Water Mobility Procedure (MWMP), and if necessary, kinetic testing. Materials determined from these tests to have the potential to generate acid or release metals ***and non-metals*** to surface water or groundwater would not be placed in the pits and would be subject to a material management plan, as necessary. As discussed in Section 2.2.18, Environmental Protection Measures and Monitoring, this plan would provide for blending and/or encapsulation of the sulfide waste rock with oxide material in a waste rock dump. These measures would minimize the potential for generation of acid rock drainage, thereby minimizing the potential impact on surface water and groundwater.

### 2.2.5 Heap Leach Facilities

#### 2.2.5.1 Heap Leach Design and Construction

Additional lifts would be added to ***two*** existing heap leach cells (Cells 1 ***and 2***), one new cell (Cell 11) would be constructed adjacent to the existing heap leach facility (Southwest Heap Leach Pad expansion), and one new heap leach facility (5-North) would be constructed adjacent to the proposed 5-North Pit (Map 2-2, Table 2-3). The proposed expansions would increase the current heap leaching capacity at the site by approximately 19.5 million tons.

Approximately 588,000 tons and 592,000 tons of leachable ore would be added to the existing heap leach cells (i.e., Cells 1 and 2, respectively). The addition of this ore would increase the height of the cells by 80 feet. Additionally, existing heap leach Cell 8 would be raised 20 feet in conjunction with construction of the proposed Southwest Heap Leach Pad expansion. This would increase the capacity of Cell 8 by 1.4 million tons. Cells 3, 4, 5a, 5b, 6, and 7 would all receive additional leachable ore totaling 3.5 million tons. This would be accomplished by

**Table 2-3**
**Existing and Proposed Heap Leach Facilities**

| Heap Leach Cell or Facility | Maximum Height (feet) | Existing Capacity (million tons) | Proposed Additional Capacity (million tons) | Total Capacity (million tons) |
|---|---|---|---|---|
| 1 | 160 | 1.9 | 0.6 | 2.5 |
| 2 | 160 | 2.4 | 0.6 | 3.0 |
| 3 | 160 | 2.6 | 1.1 | 3.7 |
| 4 | 160 | 2.8 | 0.2 | 3.0 |
| 5a | 160 | 2.5 | 0.5 | 3.0 |
| 5b | 160 | 2.6 | 0.4 | 3.0 |
| 6 | 160 | 2.5 | 0.5 | 3.0 |
| 7 | 120 | 2.7 | 0.8 | 3.5 |
| 8 | 120 | 2.0 | 1.4 | 3.4 |
| 2 & 3 Infill | 140 | 1.0 | 0 | 1.0 |
| 9 | 150 | 1.6 | 0 | 1.6 |
| 10 | 150 | 1.0 | 0 | 1.0 |
| 11 (Southwest Expansion) | ***160*** | 0 | 11.3 | 11.3 |
| 12 (5-North) | 40 | 0 | 2.1 | 2.1 |
| **TOTAL** | | 25.6 | 19.5 | 45.1 |

additional stacking within the previously permitted heights within the areas between cells.

The proposed Southwest Heap Leach Pad expansion would be constructed in a gently sloping area south of, and adjacent to, existing heap leach Cell 8. The expansion would add one cell (Cell 11) to the currently approved heap leach facility. The pad for this cell would extend over a 48-acre area. The cell would have an 11.3-million-ton capacity and a maximum height of approximately 80 feet. The proposed expansion of the existing heap facility would service all mining except the proposed 5-North Pit.

The proposed 5-North Heap Leach Pad would be constructed in a gently graded open area south of the proposed 5-North Pit. This facility would have a 30-acre footprint, a maximum height of approximately 40 feet, and a 2.1-million-ton capacity. The facility would service mining in the proposed 5-North Pit.

The heap leach piles would be developed with run-of-mine ore stacked in 15- to 20-foot lifts. Each lift would be placed at the natural angle of repose. The top of each lift would be cross-ripped to a depth of 4 feet, and solution distribution lines would be placed on the prepared surface. The leach pads would be designed with a two-liner system consisting of a ***smooth or textured (one-sided)*** 60 mil high density polyethylene (HDPE) geomembrane overlying a compacted 12-inch layer of low permeability (1 x 10-6 cm/sec) soil liner. Other geomembranes may be utilized as approved by NDEP. All construction design and installation would be consistent with the requirements of the Bureau of Mining Regulation and Reclamation's (BMRR) Water Pollution Control Permit. A field quality control program would be implemented during construction that includes membrane seam testing and seam welding equipment inspection. Progressive lifts would be constructed in a similar manner with a sufficient setback to provide an overall slope of 3H:1V to allow for decommissioning and final reclamation.

#### 2.2.5.2 Solution Ponds/ Collection System

Cyanide solution would be applied to the heaps using spray or drip irrigation systems. The total solution flow rate, including the proposed expansions, would be approximately 2,000 gallons per minute (gpm). The cyanide solution would percolate through the ore to the leachate collection system, which would gravity feed to a collection ditch. The collection ditch would be lined with a synthetic liner placed over a compacted clay base that would have a hydraulic conductivity of 10-6 centimeters per second (cm/s) or lower. Flow reporting to the collection ditch would be directed, via HDPE pipes, to the pregnant solution ponds (Figure 2-4).

The 1-acre pregnant pond and 1-acre barren pond proposed for the 5-North heap leach solution collection system would be constructed with a primary 100-mil HDPE liner over a secondary 60-mil HDPE liner above a compacted clay base. The ponds would be designed to hold the working volume of solution while maintaining a 2-foot freeboard following a 25-year, 24-hour storm event. As a result, the ponds would each have a capacity of approximately 1.2 million gallons with a 2-foot freeboard. These ponds would be covered with 1-inch mesh bird exclusion netting, attached to cables and to tie-downs off the edge of the liner. In addition, fencing that meets Nevada Division of Wildlife (NDOW) requirements would be installed around the solution ponds, solution channels, and solution overflow ponds to prevent access by wildlife and livestock (see Section 2.2.14).

The leachate collection system for the proposed Southwest Heap Leach Pad expansion would utilize the existing fluid management system, process ponds, and appurtenant infrastructure previously established for the existing heap leach cells. Pregnant solutions would be pumped to carbon columns where gold would be adsorbed onto the carbon (see Section 2.2.7, Process Area). The solution would then gravity feed to the barren pond for subsequent reuse in the heap leach process.

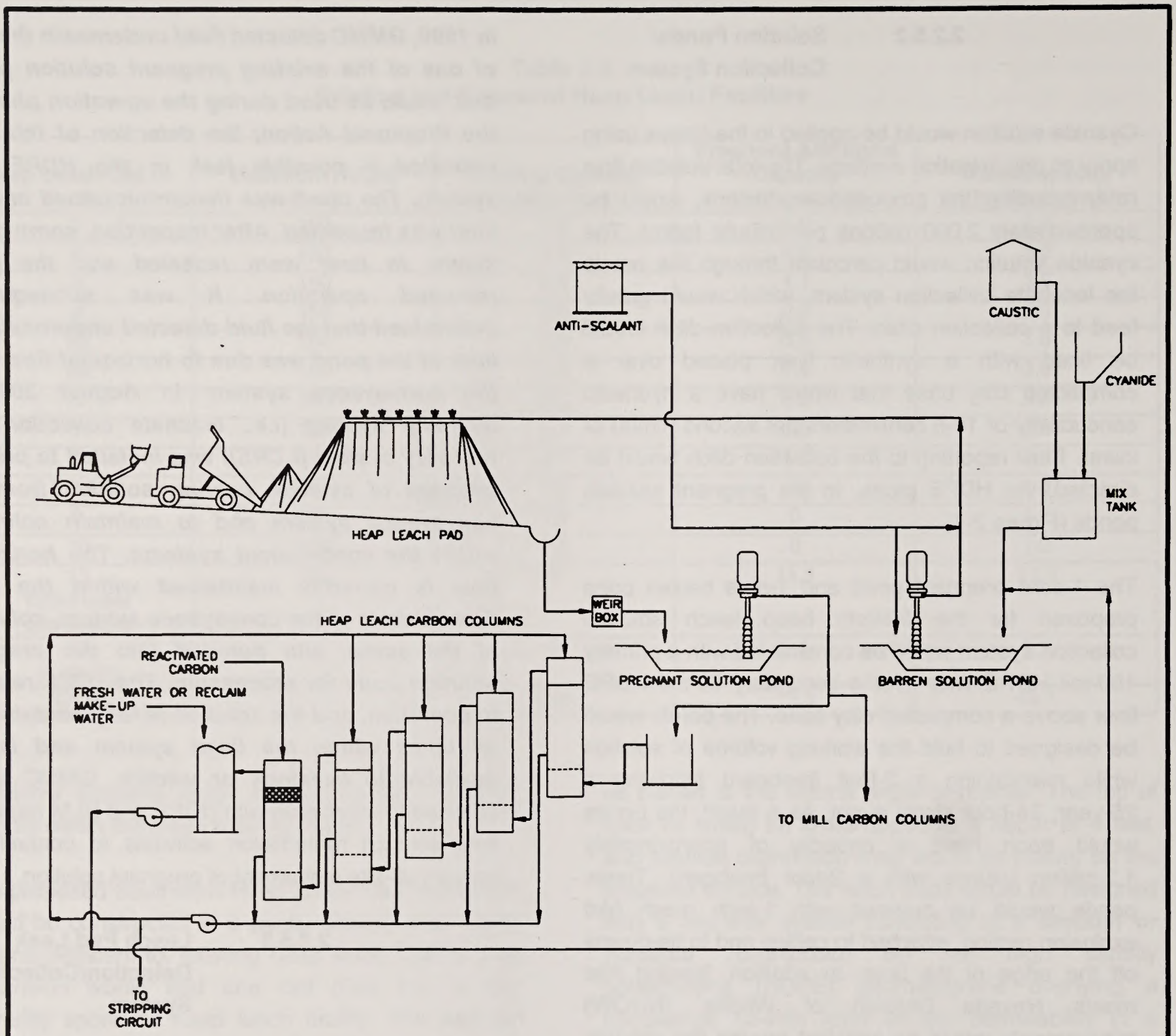
***In 1999, GMMC detected fluid underneath the liner of one of the existing pregnant solution ponds that would be used during the operation phase of the Proposed Action; the detection of this fluid indicated a possible leak in the HDPE liner system. The pond was decommissioned and the liner was inspected. After inspection, some of the seams in liner were resealed and the pond resumed operation. It was subsequently determined that the fluid detected underneath the liner of the pond was due to horizontal flow from the conveyance system. In August 2000, a retaining system (i.e., leachate collection and recovery system [LCRS]) was installed to prevent seepage of cyanide bearing solution from the conveyance system and to maintain solutions within the containment systems. The horizontal flow is currently maintained within the lined French drain of the conveyance system, collected at the sump, and pumped into the pregnant solution pond for processing. The LCRS remains in operation, and the solution is fully contained at all times within the lined system and is not available to livestock or wildlife.*** GMMC would continue to coordinate with NDEP and BLM regarding their solution remediation activities to contain and prevent off-site movement of pregnant solution.

#### 2.2.5.3 Leach Pad Leak Detection/Collection System

Leak detection/collection systems would be installed between the two HDPE liners in the proposed pregnant and barren ponds. The leak detection systems would be designed to provide containment and collection of leaks through the primary liner. The leak detection/collection systems would be designed based on NDEP regulations.

### 2.2.6 Ore Crushing Plant

High-grade ore mined from the pits would be crushed at the existing crushing facility in preparation for milling. The existing crushing facility includes a jaw crusher, cone crusher, coarse and fine ore stockpiles,




Not to scale

Marigold Mine

Figure 2-4

Heap Leach Circuit with Carbon Columns

and conveyers and screens for transfer and sizing, as previously approved under POO No. N26-88-005P and other existing permits. Ore crushing operations are expected to be discontinued during the 3-year scheduled shutdown of the mill that would occur during the first years of operation under the Proposed Action (see Section 2.2.7). During this period, ore would be stockpiled for processing. After this 3-year period, the milling operations would be reactivated and run continuously for the remainder of the project life. The ore crushing plant would be periodically utilized for crushing and screening of material for construction projects.

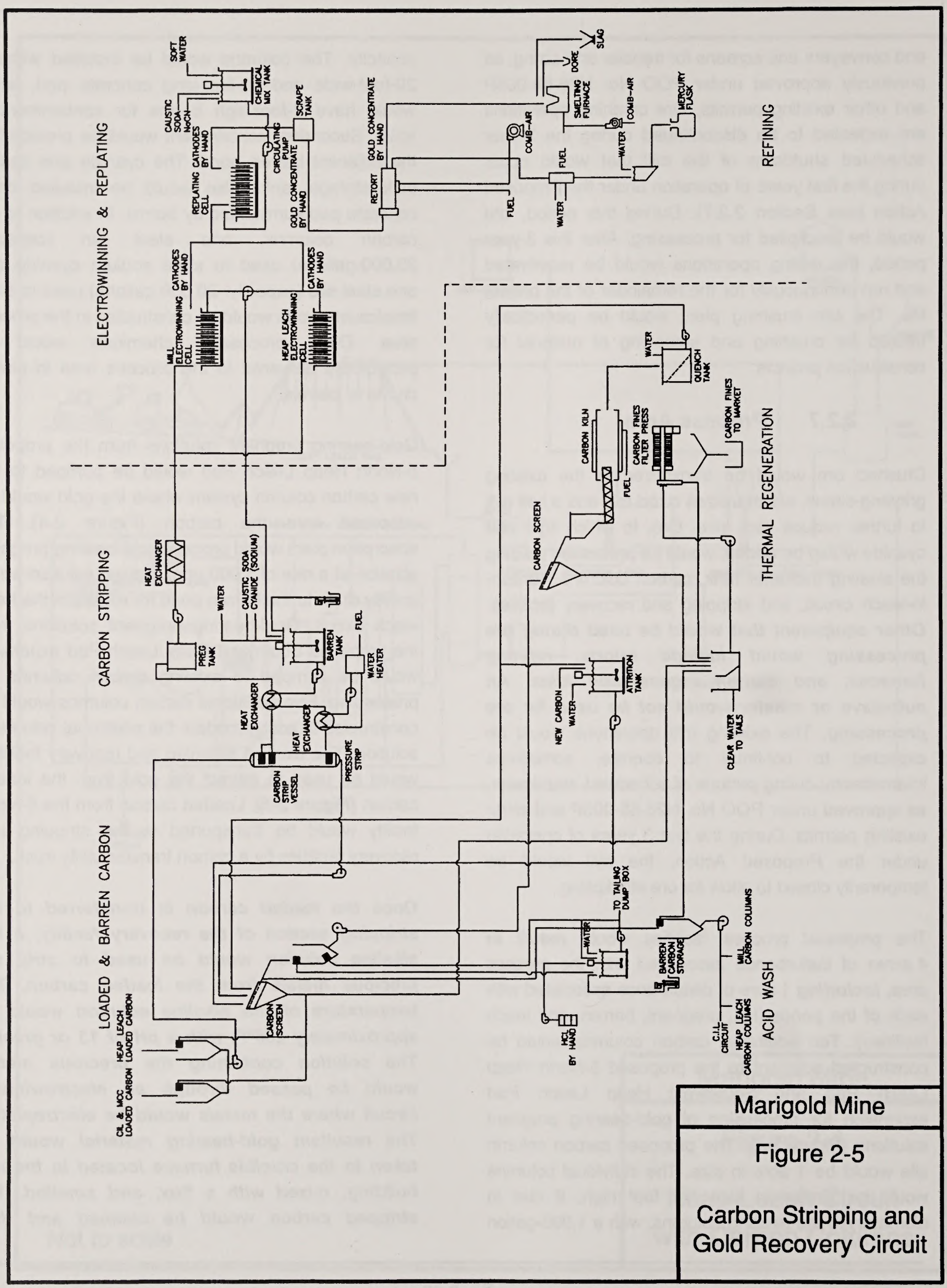
### 2.2.7 Process Area

Crushed ore would be transferred to the existing grinding circuit, which utilizes a rod mill and a ball mill to further reduce rock size. Ore, to which lime and cyanide would be added, would be processed utilizing the existing thickener tank, carbon columns, carbon-in-leach circuit, and stripping and recovery facilities. ***Other equipment that would be used during ore processing would include retorts, refining furnaces, and carbon regeneration kilns. An autoclave or roaster would not be used for ore processing.*** The existing mill operations would be expected to continue to operate, sometimes intermittently during periods of scheduled shutdowns, as approved under POO No. N26-88-005P and other existing permits. During the first 3 years of operation under the Proposed Action, the mill would be temporarily closed to allow for ore stockpiling.

The proposed process facilities would ***result in*** 4 acres of disturbance associated with the process area***, including*** 1 acre of disturbance associated with each of the ponds (i.e., pregnant, barren, and leach facilities). Ten additional carbon columns would be constructed adjacent to the proposed 5-North Heap Leach Pad and Southwest Heap Leach Pad expansion for processing of gold-bearing pregnant solutions (Figure 2-4). The proposed carbon column site would be 1 acre in size. The individual columns would be similar in size (12 feet high, 8 feet in diameter) to the existing columns, with a 1,000-gallon capacity. The columns would be installed within a 20-foot-wide and 60-foot-long concrete pad, which would have 2-foot-high berms for containment of spills. Secondary containment would be provided by the adjacent barren pond. The cyanide and caustic bulk storage tanks also would be installed on a concrete pad surrounded by berms. In addition to the carbon columns, one steel bin (capacity: 20,000 gallons) used to store sodium cyanide and one steel silo (capacity: 20,000 gallons) used to store lime/caustic soda would be constructed in the process area. Other processing chemicals would be periodically delivered to the process area in plastic drums or barrels.

Gold-bearing pregnant solutions from the proposed 5-North Heap Leach Pad would be pumped to the new carbon column system where the gold would be adsorbed onto the carbon (Figure 2-4). The adsorption plant would process gold-bearing pregnant solution at a rate of 1,000 gpm. Barren solution would gravity drain to the barren pond for re-use in the heap leach circuit. Gold-bearing pregnant solutions from the proposed Southwest Heap Leach Pad expansion would be pumped to existing carbon columns for processing. Five additional carbon columns would be constructed to accommodate the additional volume of solution. The existing stripping and recovery facilities would be used to extract the gold from the loaded carbon ***(Figure 2-5)***. Loaded carbon from the 5-North facility would be transported to the stripping and recovery facilities by a carbon transfer utility truck.

***Once the loaded carbon is transferred to the stripping section of the recovery facility, a hot alkaline solution would be used to strip the precious metals from the loaded carbon. The temperature of the alkaline solution would be approximately 285°F, with a pH of 13 or greater. The solution containing the precious metals would be passed through an electrowinning circuit where the metals would be electroplated. The resultant gold-bearing materiel would be taken to the crucible furnace located in the mill building, mixed with a flux, and smelted. The stripped carbon would be cleaned and then***




Marigold Mine

Figure 2-5

Carbon Stripping and Gold Recovery Circuit

***reactivated by heating in a rotary kiln. The crucible furnace, mercury retort, and rotary kiln are operated in accordance with air quality operating permit No. AP1041-0158.***

### 2.2.8 Tailings Impoundments

Additional tailings storage capacity is required for the Proposed Action. This capacity would be achieved by adding a 5-foot lift to the existing impoundment and/or by constructing a new impoundment. During operation of the existing tailings impoundment, a tailings solution plume was identified in 1992 to the north of the tailings dam, based on data collected in groundwater monitoring wells. As a result, GMMC submitted a proposed tailings remediation plan to NDEP. GMMC's proposed groundwater remediation options included:

- Improved fluid management
- Physical modifications and improvements to the tailings impoundment
- Expanded groundwater monitoring wellfield
- In-situ tailings impoundment dewatering well
- Tailings solution chemical treatment

A tailings solution pumpback system (TSPS) was installed in 1988 in the tailings impoundment. Since the identification of the tailings plume in 1992, the efficiency of the TSPS has been improved to decrease the release of tailings solution to the vadose zone. In 1996, a separator dike was constructed along the western and northern portions of the tailings impoundment to 1) facilitate operations, 2) improve fluid management, and 3) limit contact of the tailings solution with the western and northern portions of the dam. A second dike was constructed to divide the impoundment into two cells and to improve fluid management. A sump was installed within the divider dike as a collection point for the tailings reclaim water to reduce the hydraulic head, thereby reducing the leak from the tailings dam, and to control the location where the fluid enters the tailings impoundment. The sump has not changed the quantity of water pumped by the TSPS, but it has improved the efficiency of the system, and it intercepts solution before it reaches the tailings dam.

The tailings reclaim system currently captures and returns approximately 350 gallons per minute (gpm) of reclaim water to the mill during periods of mill operation and 150 gpm to the heap leach system. The west cell of the tailings impoundment (Cell A) is currently dry except for periodic irrigation of vegetative cover and spraying for dust control. Tailings are directed to the east cell (Cell B) that currently has a surface pond covering an area of approximately 80,000 square feet (400 feet by 200 feet). Water from the pond is used for dust control and irrigation within the tailings impoundment.

These tailings impoundment modifications have reduced the hydraulic head, lowering the leakage rate and the areal extent of the leakage plume. The seepage from the tailings impoundment has decreased from approximately 110 gpm observed in 1992 to the current rate of approximately 34 gpm (GMMC 1999). Three new tailings dam observation holes (TDOHs) or monitoring wells (TDOH numbers 18, 19, and 20) were installed within the existing well field to improve the monitoring system and to replace wells made obsolete by regional dewatering.

As a result of these modifications to the tailings impoundment and the associated groundwater monitoring system, NDEP has not required GMMC to implement the remaining options in their proposed tailings remediation plan. Should groundwater monitoring indicate expansion of the plume, these options would be considered for future implementation.

Studies, including tailings characterization and dewatering options, are currently being conducted for the existing tailings impoundment to evaluate the feasibility of expanding the existing impoundment. If the remediation measures described above are successful, construction of the proposed second tailings impoundment would not be required, and a 5-foot lift would be constructed on the existing tailings dam to provide the needed additional capacity for

tailings disposal. Construction of the lift would be completed in accordance with NDEP requirements.

Under the Proposed Action, a second tailings impoundment (Tailings Dam #2) would be constructed to the south of the existing tailings impoundment to provide additional capacity for the disposal of tailings if remediation measures of the existing tailings impoundment are unsuccessful, as determined by NDEP (Map 2-2). The proposed tailings impoundment would be sized to handle approximately 0.82 million tons of tailings, at an estimated density of 23.5 cubic feet per ton, without allowances for reclaim water management or freeboard. These allowances would be incorporated with the proposed 37-foot gross height, as dictated by actual mining conditions. Approximately 54 acres of disturbance would be associated with the proposed impoundment area and dam. The tailings dam would be located in a gently sloping area founded on stable colluvium deposits. The impoundment would be lined with 12 inches of compacted clay, which has a saturated hydraulic conductivity of 5.0 x 10-7 cm/s. If the clay material on site cannot be compacted to meet this specification, a synthetic liner (60 or 80 mil) would be used. The inside walls of the dam would have a 3-foot compacted clay liner. The leak detection system has not yet been designed, but the facility would be approved by the State and meet state specifications before construction. Design specifications for the impoundment, as well as leak detection and collection pumpback system, would be developed in accordance with State of Nevada requirements. ***The number and locations of monitoring wells established downgradient of the tailings impoundment would be determined by the appropriate agencies.***

### 2.2.9 Growth Media Stockpile Areas

Prior to construction of the proposed mine pits, waste rock dumps, roads, heap leach pads, and tailings impoundment, growth media would be stripped and stockpiled for subsequent use in reclamation. To accommodate the anticipated volume of growth media that would be salvaged, five new growth media stockpiles would be developed (Map 2-2). The stockpiles would cover approximately 5 acres and would be located west of the proposed 5-North Pit, northwest of the proposed 8-North Pit, southwest of the proposed 5-North Heap Leach Pad, and east of the proposed Southwest Heap Leach Pad expansion. An 8-acre growth media stockpile also would be established to the south of the proposed tailings impoundment. Growth media stockpiles would be seeded to minimize wind and water erosion and invasion by noxious weeds.

### 2.2.10 Storm Water Control

Storm water surface flows would be routed away from the project area by installation of new diversion ditches (see Section 2.2.2.2). Diversion ditches would be constructed to accommodate flow resulting from a 100-year storm event. Storm water that accumulates in the pits during operations would be pumped to existing process facilities or storm water ponds. Tailings reclaim water from the existing and proposed impoundments would be pumped to the mill for reuse in gold recovery operations. Runoff from the waste rock dumps, due to extreme meteoric events, would generally be directed via ***berms constructed around the dumps*** to diversion ditches and eventually to the storm water ponds. ***Storm water would be monitored in accordance with state requirements for storm water pollution prevention that would be effected as a result of permitting activities under the General Nevada Storm Water General Discharge Permit #GNV 300000. In addition to other requirements identified in Table 1-3, these permitting activities would be an ongoing part of the project, and permit approval would be obtained prior to beginning operations. A storm water monitoring plan would be developed as a part of related permit applications and submittals to the state. General monitoring schedules that may be specified include quarterly or monthly monitoring in addition to monitoring after major storm or snowmelt events. Additional monitoring and control technologies would be further specified as part of Water Pollution Control***

***permitting activities with the state.*** Storm water would be managed as process solutions if they contact solutions containing cyanide. Design criteria for storm water management is addressed in the facility design. Storm water would be stored in the storm water storage pond located adjacent to the existing solution ponds and would be utilized for dust suppression, process water, or irrigation for reclaimed areas.

Two additional storm water ponds would be constructed under the Proposed Action (Map 2-2). One 1-acre pond would be constructed adjacent to the proposed 5-North Heap Leach Pad. A 2-acre pond would be constructed in conjunction with the proposed Southwest Heap Leach Pad expansion.

Access roads would be graded to promote positive drainage to adjacent side ditches for storm water removal. Best Management Practices (BMPs) would be used to limit erosion and sediment transport on steeper grades. None of the proposed access roads would cross any perennial or intermittent streams. Culverts would be installed for crossing significant drainage swales, and low water crossings would be utilized on non-significant topographic rilles and gullies.

### 2.2.11 Water Supply

Reclaim water from the tailings impoundment and storm water run-off from mine facilities are currently recycled to the extent possible for use in leaching, milling, and dust suppression. The use of recycled water would continue in order to minimize the amount of fresh water needed for the operation. Fresh water for the existing operation is currently supplied by an interconnect with the Lone Tree Mine water supply line and three water supply wells located within the mine area. Through a cooperative agreement with the Lone Tree Mine and subsequent BLM approval (BLM 1997 [Resort Project EA]), the interconnect to the supply system serving Lone Tree's Trenton Canyon facility can supply approximately 90 to 95 percent of the processing water requirements, up to an additional 1,000 gpm. The well system is capable of providing approximately 425 gpm. The existing fresh water supply systems and the continued use of recycled water would supply sufficient water for the existing and proposed operations.

### 2.2.12 Electric Power

The northeast portion of the proposed 5-North Pit development, as currently planned, would extend into the Sierra Pacific Power Company (SPPCo) right-of-way (ROW) (NEV-066891) that contains a 120-kilovolt (kV) power line. A power line realignment would be required to avoid the area proposed for development. GMMC would pursue obtaining permission from SPPCo for realignment of the power line and the necessary ROW applications. The 60-foot height of the line would allow sufficient safety margin for mining personnel and equipment. GMCC would inform SPPCo of the proposed blasting techniques that would be used in the northern portion of the pit. Controlled blasting in the pit would not produce flying debris that could damage the line. Power distribution for the 5-North facilities would come from the existing power line at the Water Supply Well #3 located in Section 5 (T33N, R43E).

### 2.2.13 "In Fill" Areas

"In fill" areas, totaling approximately 72 acres, would be located in between the proposed and/or existing project facilities. These areas would be used for access between facilities. In addition, portions of the "in fill" areas could be used as laydown yards for storage of extra pipe, culverts, and other non-hazardous items. No hazardous materials would be stored in the "in fill" areas, unless properly stored and contained. These proposed "in-fill" areas include a 30-acre area between the existing 8-South Pit and the proposed 8-North Pit, a 22-acre area southeast of the proposed Southwest Heap Leach Pad extension, and a 20-acre site located west of the existing Top Zone Pit.

### 2.2.14 Security and Fencing

Security in the project area would be the responsibility of GMMC. The security system would include direct security measures, supported by employees involved in the day-to-day operation. Persons entering and leaving the area would be required to gain clearance through a gate located near the entrance to the mine site. A three-strand barbed wire fence exists along the current permit boundary. Additional chain link fencing and electronic gates prevent unauthorized access to the mill area, administration building, and shop facilities. The proposed permit boundary would be partially enclosed with a BLM-approved range control fence (i.e., four-strand barbed wire fence). Fencing that meets Nevada Division of Wildlife (NDOW) requirements would be installed around the solution ponds, solution channels, and solution overflow ponds to prevent access by wildlife and livestock; this fencing currently surrounds existing process ponds and channels. Any monitoring wells located outside the fenced area would be clearly marked and locked. Additional fences or controls would be installed as necessary.

### 2.2.15 Fire Protection

Range fires detected within the project vicinity would be reported to GMMC's Safety Supervisor. The Safety Supervisor would report the range fire to the BLM and adjacent landowners. Support equipment available to fight range fires includes three water trucks with hose, a fire trailer equipped with two 100-pound extinguishers, hoses, nozzles, and fittings. In addition, fire suppression systems are installed on all haul trucks, loaders, drills, and dozers.

### 2.2.16 Exploration Drilling Pads, Access Roads, *and Sumps*

Exploration drilling activities would continue under the Proposed Action. The objectives of the drilling program would be to identify new ore reserves and to provide support data for short- and long-term mine planning. Drilling would be conducted within the proposed permit boundary, primarily south of the project facilities in T33N, R43E.

Drill pads ***and sumps***, when used, would typically be 40 feet wide by 40 feet long. Access roads to the drill pad sites would be approximately 20 feet wide with an operating width of 12 feet. Existing roads would be used, where possible, to minimize new disturbance. New roads would only be constructed when existing roads or overland travel would not provide safe, efficient access.

In steep terrain, growth media from drill pads and roads would be stripped and stockpiled for use during reclamation activities. Each drill pad would be constructed with two mud pits; one would be used for settling of the drill cuttings, and the second would be used for settling of the mud solids. A berm would be constructed on the downhill side of each drill pad to provide containment and prevent runoff from the drill pad area.

### 2.2.17 Hazardous Materials and Wastes

#### 2.2.17.1 Reagent Transport and Storage

No changes to the chemicals utilized, or the approximate quantities transported and stored on-site, would occur under the Proposed Action. All process chemicals and petroleum products would continue to be handled and disposed of in accordance with applicable Nevada and MSHA laws and regulations. Information and permits pertaining to the management, use, and storage of hazardous materials are provided in Table 2-4. The hazardous materials utilized at the mine are handled pursuant to manufacturers' Material Safety Data Sheets (MSDS) and applicable regulations. Transportation and handling of chemicals are conducted by licensed carriers and properly trained workers. All vehicles and containers carry the appropriate placards. All chemicals would continue to be transported to the mine by licensed commercial carriers on public roadways in accordance with applicable regulations. Routes used to transport chemicals include I-80 and

**Table 2-4**
**Hazardous Materials Summary**

| Chemical Name | Use | Typical Rate of Use | Typical Amount Stored | Storage Method | Waste Management/ Disposal | Hazardous Characteristic | Amount per Load |
|---|---|---|---|---|---|---|---|
| Sodium cyanide | Process facility | 2,240,000 lbs/yr | 120,000 lbs | Steel bins | Spent | Poison | 29.6 tons |
| Sodium hydroxide | Process facility | 1,800,000 lbs/yr | 150,000 lbs | Plastic barrels | Spent | Corrosive | 24.3 tons |
| Lime | Process facility | 2,184,000 lbs/yr | 84,000 lbs | Steel silo | Spent | Corrosive | 42 tons |
| Muriatic acid | Process facility | 6,500 lbs/yr | 3,000 lbs | Steel silo | Spent | Corrosive | 30 gal |
| Betz liquid flocculent | Process facility | 5,500 lbs/yr | 2,750 lbs | Plastic drums | Spent | Corrosive | 11,250 gal |
| Betz antiscale | Process facility | 20,000 lbs/yr | 15,000 lbs | Plastic drums | Spent | Corrosive | 11,250 gal |
| Phosphonic acid | Process facility | 1,500 lbs/yr | 800 lbs | Plastic drums | Spent | Corrosive | 800 lbs |
| Propane | Office, lab, process facility, truck shop | 191,000 gal/yr | 12,000 gal | Pressurized steel tank | Spent | Flammable | 11,250 gal |
| Diesel | Truck stop | 1,050,000 gal/yr | 40,000 gal | Steel tank | Spent | Flammable | 11,000 gal |
| Gasoline | Truck stop | 104,000 gal/yr | 10,000 gal | Steel tank | Spent | Flammable | 10,000 gal |
| Antifreeze | Truck stop | 800 gal/yr | 400 gal | Tote (bulk container) | Recycle | Poison | 400 gal |
| Acetylene | Truck stop | 22,900 lbs/yr | 440 lbs | Pressurized cylinders | Spent | Explosive | 2 cylinders |
| Oxygen | Truck stop | 20,800 lbs/yr | 400 lbs | Pressurized cylinders | Spent | Explosive | 2 cylinders |
| Ammonium nitrate/ fuel oil (ANFO) | Mine | 2,500 tons | 30 to 40 tons | Steel silo | Spent | Explosive | 35 to 37 tons |
| Various explosives | Mine | 15,000 lbs/yr | 15,000 lbs | Bags | Spent | Explosive | 7.5 tons |

the Buffalo Valley Road. Chemicals are stored at the existing facilities and protected from the elements. Petroleum fuels are stored in aboveground tanks and surrounded with a containment structure to accommodate at least 110 percent of the volume of the largest tank within the containment area. Most of the storage tanks are double-walled. The tanks are located in compacted clay basins with a clay berm covered by waste rock. The concrete-lined floor and walls of the mill have the capacity to contain 150 percent of all fluids contained in the mill.

Chemicals used in the mill are stored nearby in concrete-lined basins with concrete side walls and capacity for 125 percent of the largest container.

GMMC has been issued a Hazardous Materials Permit by the State Fire Marshal Division, Hazardous Materials Section. The issuance of this permit is contingent on GMMC meeting the State standards for hazardous material storage and containment. If required, additional spill containment facilities would be installed to reduce the probability of a significant release.

A Hazardous Material Spill and Emergency Response Plan has been prepared for the existing mine facilities in accordance with the State of Nevada regulations governing the design, construction, operation, and closure of mining operations (Nevada Administrative Code 445A.242 through 445A.243).

#### 2.2.17.2 Spill Prevention and Emergency Response

The chemicals and petroleum products utilized by and consumed at the Marigold Mine are not expected to change as a result of the Proposed Action (Table 2-4). Of the chemicals stored and utilized on-site, sodium cyanide, muriatic acid (hydrochloric acid), and sodium hydroxide are hazardous substances that are listed in 40 CFR 302.4 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (including The Emergency Planning and Community Right-to-Know Act); and the hazardous substances appendices of the Superfund Amendments and Reauthorization Act (SARA). CERCLA provides a framework for Federal response to the release of hazardous substances. For purposes of emergency response planning under SARA, Title III, a threshold planning quantity and reportable quantity are established for each hazardous substance. In conformance with these regulations, GMMC has developed and implemented an Emergency Response Plan for the Marigold Mine. Implementation of this plan would continue under the Proposed Action. These plans provide for the tracking and required reporting of hazardous substances used on-site as well as provide a system for prevention, discovery, notification, and safe cleanup of all spills or discharges that may impact the environment.

Materials that are classified as hazardous for transportation purposes are regulated by the U.S. Department of Transportation (USDOT) per 49 CFR 172.101. The USDOT hazardous materials list includes hazardous substances regulated under CERCLA, as well as other types of chemicals. In addition to the hazardous substances described above, transportation of ammonium nitrate, Class A explosives, diesel fuel, cement, and calcium oxide (lime) must comply with USDOT hazardous materials packaging and labeling requirements. All chemicals would continue to be stored and handled in accordance with the manufacturer's recommendations and state regulations. The MSDSs for all chemicals used at the mine site would continue to be kept at locations that are accessible to the employees.

#### 2.2.17.3 Waste Management

Non-hazardous solid waste generated at the Marigold Mine would continue to be disposed of in the approved Class III landfill located on the south side of the 8-South Waste Rock Dump in accordance with State and Federal regulations. No hazardous wastes, liquid wastes, or petroleum products would be disposed of at the site. The landfill would continue to be inspected weekly to ensure that only non-hazardous solid waste is deposited in the landfill.

GMMC currently recycles all used oil, solvents, antifreeze, and batteries through licensed contractors. Bio-remediation of soils impacted by occasional spills of petroleum hydrocarbons is currently permitted on-site by the State of Nevada, Department of Conservation and Natural Resources, Bureau of Mining Regulation and Reclamation. All lavatory wastes would continue to be disposed of in the existing septic systems.

### 2.2.18 Environmental Protection Measures and Monitoring

Environmental protection measures and monitoring for the Proposed Action would include sediment control, waste rock characterization, pit lake study (8-North Pit), spill prevention sampling and monitoring, stability of facilities, wildlife and livestock protection, air quality dust control, cultural/ paleontological resource protection, and an employee environmental education program.

#### 2.2.18.1 Sediment Control

Sediment control would be provided by a combination of Best Management Practices (BMPs) at each facility. The heap leach and chemical/petroleum storage areas would be contained in an exclusionary berm. The petroleum fueling area also has its own concrete containment pad for incidental spills. The tailings and waste rock dumps would have storm water diversion ditches to prevent runoff from entering the facilities. The waste rock dumps would be reclaimed concurrently to reduce sediment loss. This would include ripping compacted surfaces to increase permeability to the vegetation root zone. Stream diversions would be armored where flow velocities exceed approximately 4 feet per second, dependent on channel material.

#### 2.2.18.2 Waste Rock Characterization

Waste rock samples would be submitted quarterly for analysis as required by the NDEP Bureau of Mining Regulation and Reclamation. Waste rock analyses would include MWMP, ABA analysis, and heavy metal and general chemistry analyses as outlined in the site's Water Pollution Control Permit. Analyses would be reported quarterly to the NDEP and BLM. If the ABA tests exceed the NDEP and BLM criteria, then kinetic testing (humidity cell tests) would be performed.

To date, waste rock analyses have indicated ***low*** potential for acid generation due to the low sulfide content of the waste rock. If waste rock analyses were to indicate the material had the potential to generate acid, that portion of the waste rock would be subject to a BLM-approved materials management plan (i.e., Sulfide Waste Management Plan). The plan would provide for blending and/or encapsulation of the sulfide waste rock in oxide material at one of the out-of-pit waste rock dumps. A minimum blending ratio of 3:1 acid-neutralizing to acid-generating material would be used. A minimum depth of 20 feet of oxide material would be used to encapsulate unblended sulfide material, and a minimum depth of 15 feet would be used to encapsulate blended material. These measures would reduce the potential for generation of acid rock drainage, thereby reducing the potential impact on surface and groundwater.

#### 2.2.18.3 Spill Prevention Sampling

**Storm Water Discharge**

Storm water discharge samples would be collected from drainages exiting the project's permitted boundary from areas of exposed waste rock materials. Samples would be analyzed for the effluent parameters listed in 40 CFR 440.104(d)(1). Monitoring data would be reported to the NDEP on an annual basis. ***Additional monitoring and control technologies would be further specified as part of state permitting activities (i.e., General Storm Water Permit #GNV 300000), which includes applications and reviews for Storm Water General Discharge and Water Pollution Control permits as identified in Table 1-3.***

**Groundwater Monitoring**

Groundwater samples would be collected from the tailings dam monitoring wells on a quarterly basis. The samples would be analyzed for the constituents specified in the site's Water Pollution Control Permit. Monitoring data would be submitted to the NDEP on a quarterly basis.

**Production Wells**

Samples would continue to be collected from the site's fresh water production wells on an annual basis. The samples would be analyzed for the constituents specified in the site's Water Pollution Control Permit. Monitoring data would be submitted to the NDEP on an annual basis.

**Process Solutions**

Monitoring samples would be collected and analyzed from the leach pad monitoring ports and the leach pad collection ditch leak sumps on a quarterly basis. Samples from the pregnant ponds, barren ponds, storm water ponds, tailings liquor, and tailings reclaim water would be collected and analyzed annually. These process solutions would be analyzed for the constituents specified in the site's Water Pollution Control Permit. Quarterly reporting of results would be made to the NDEP. Additionally, weekly flow rates for the tailings dam interceptor ditch sumps, leach pad leak detection sumps, pregnant pond and barren pond leak detection sumps, and storm water pond leak detection sumps would be documented and reported.

### 2.2.18.4 Stability of Facilities

Waste rock dumps and heap leach facilities would be designed to ensure stability during operation and post-closure. Stability modeling results for the heap leach pads and waste rock dumps would be included in the application for the NDEP Bureau of Mining Regulation and Reclamation permits. These facilities would be monitored on a regular basis during operations to identify any visible stability problems.

Expansion of the existing tailings facility under the Proposed Action would accelerate the seepage from the north end of the tailings if measures to control the seepage were not undertaken. GMMC has committed to controlling the seepage from the existing tailings and is working with the NDEP to protect groundwater quality north of the tailings impoundment.

### 2.2.18.5 Wildlife and Livestock Protection

To prevent access by wildlife and livestock, fencing that meets NDOW requirements would be installed around solution ponds, solution overflow ponds, and solution channels. The proposed permit boundary would be partially enclosed with a BLM-approved range control fence (four-strand barbed wire). Chain link fencing currently surrounds the process area. Any monitoring wells located outside the fenced area would be clearly marked and locked. Additional fences and controls would be installed as necessary. To date, GMMC has not experienced a wildlife mortality in the tailings facility.

Additional protection measures that have been incorporated into the operation for the protection of wildlife and livestock include: 1) installation of netting over solution channels and ponds to prevent access by birds and bats, 2) proper management of the Class III landfill, 3) formalized procedures for verbal and written reporting of wildlife mortalities to the NDOW, and 4) monitoring and managing cyanide concentrations of the process solutions.

GMMC has committed to contracting with a qualified biologist to conduct breeding bird surveys within ***all*** suitable habitats prior to ground disturbance, if construction activities were to occur from March through July. This survey would identify either breeding adult birds (i.e., by territorial defense behavior) or nest sites within the areas to be disturbed. If active nests are present, GMMC would then coordinate with the BLM to develop appropriate protection measures for these sites, which may include avoidance, construction constraints, buffer establishment, etc. An option to conducting breeding

bird surveys would be to avoid ground disturbance activities between March and July, allowing construction to proceed outside of the breeding season without clearance surveys.

Expansion of the Red Rock Pit would directly impact the Red Rock Adit, which has been identified as bat habitat. ***This adit receives occasional use by the small-footed myotis (as indicated by guano deposition) and Townsend's big-eared bat; however, there is no evidence of use of this adit as a hibernaculum or as a maternity site. This adit lacks the depth, complexity, and air movement generally preferred for use as hibernacula or maternity sites. Observations during bat surveys indicate that this adit receives occasional use for day roosting and night roosting between feeding bouts. Similar habitats are abundant in the Battle Mountain Range. GMMC previously installed three bat gates at adits and one fence around a shaft as mitigation for impacts to bat habitat. These mitigation measures were conducted off-site and would not be impacted by the Proposed Action or Alternatives.***

GMMC would contract a qualified bat biologist, prior to the initiation of construction activities, to close the Red Rock Adit during the appropriate season (e.g., spring or fall) to prevent direct impacts to bats and encourage individuals to relocate to adjacent habitats. It is anticipated that the exclusion would occur during early fall after summer use of the adit has ceased and prior to the winter season. Prior to closure, the entrance/exit would be monitored at dusk, using appropriate survey methods to approximate the number of bats that are using the adit. A tally of bats exiting and entering the entrance would be made to provide an estimate of the number of bats inhabiting the adit. Based on site-specific conditions, the number of bats observed, and environmental factors, applicable techniques would be implemented to force the bats out of the Red Rock Adit. This closure would allow bats to leave the adit, but not return. Screening would remain on the entrance until permanent closure could be implemented. Permanent closure would consist of either mining the adit or backfilling the entrance to prevent bats from using the site in the spring.

#### 2.2.18.6 Air Quality

GMMC has incorporated a number of measures into the existing operation to control the generation of $PM_{10}$. These measures also would be incorporated into the operation of the Proposed Action. To control fugitive dust, water or chemical stabilizers would be applied to haul roads, access roads, and at the tailings impoundment within the project area. Speed restrictions would be enforced to further minimize particulate emissions from roadways. Ongoing reclamation during the life of the operation, as project components are completed, would reduce the acreage of disturbed lands, thereby reducing fugitive dust. Enclosures, baghouses, and sprays currently control dust emissions from existing crushers, screens, and transfer points.

#### 2.2.18.7 Cultural/ Paleontological Resources

Protection measures have been incorporated into the existing operation to prevent and minimize potential impacts to cultural and paleontological resources within the project area. These measures, identified below, also would provide protection of resources during development and operation of the Proposed Action.

- Employee and equipment access would be limited to minimize the potential for direct impacts to resources. Mine exploration and operations equipment would be prohibited outside of the proposed permit boundary, which would be clearly marked. Employee access to known archaeological and paleontological sites on private land in the vicinity of the mine would be limited.

- Known site locations would be avoided by exploration activities.

- Secondary effects to eligible sites resulting from road and drill pad construction and use would be minimized through the implementation of erosion control measures such as water bars, double sumps for drill water, and appropriate road design.

- If a previously undocumented archaeological site or subsurface components of documented sites are discovered during exploration, construction, operation, or reclamation activities, GMMC would cease activities in the area of the discovery until resources could be examined by a BLM-approved archeologist. If resources are identified as eligible for the National Register of Historic Places (NRHP), impacts would be mitigated through an appropriate treatment plan approved by the BLM, the State Historic Preservation Officer (SHPO), GMMC, and the Advisory Council, or through site avoidance.

- If significant fossiliferous deposits, specifically vertebrate fossil deposits, are located during exploration, construction, operation, or reclamation activities, ***the BLM*** would be notified, and measures would be taken to identify and preserve or avoid the fossils.

#### 2.2.18.8 Employee Environmental Education Program

GMMC currently provides environmental education for its employees. This training includes information on management practices incorporated into the operation of the facility to minimize impacts to the environment and ensure compliance with environmental permit criteria. This program would be continued throughout the operation of the Proposed Action. GMMC also is developing an operator's Environmental, Health, and Safety Compliance Handbook, in addition to maintaining detailed compliance schedules.

## 2.2.19 Reclamation

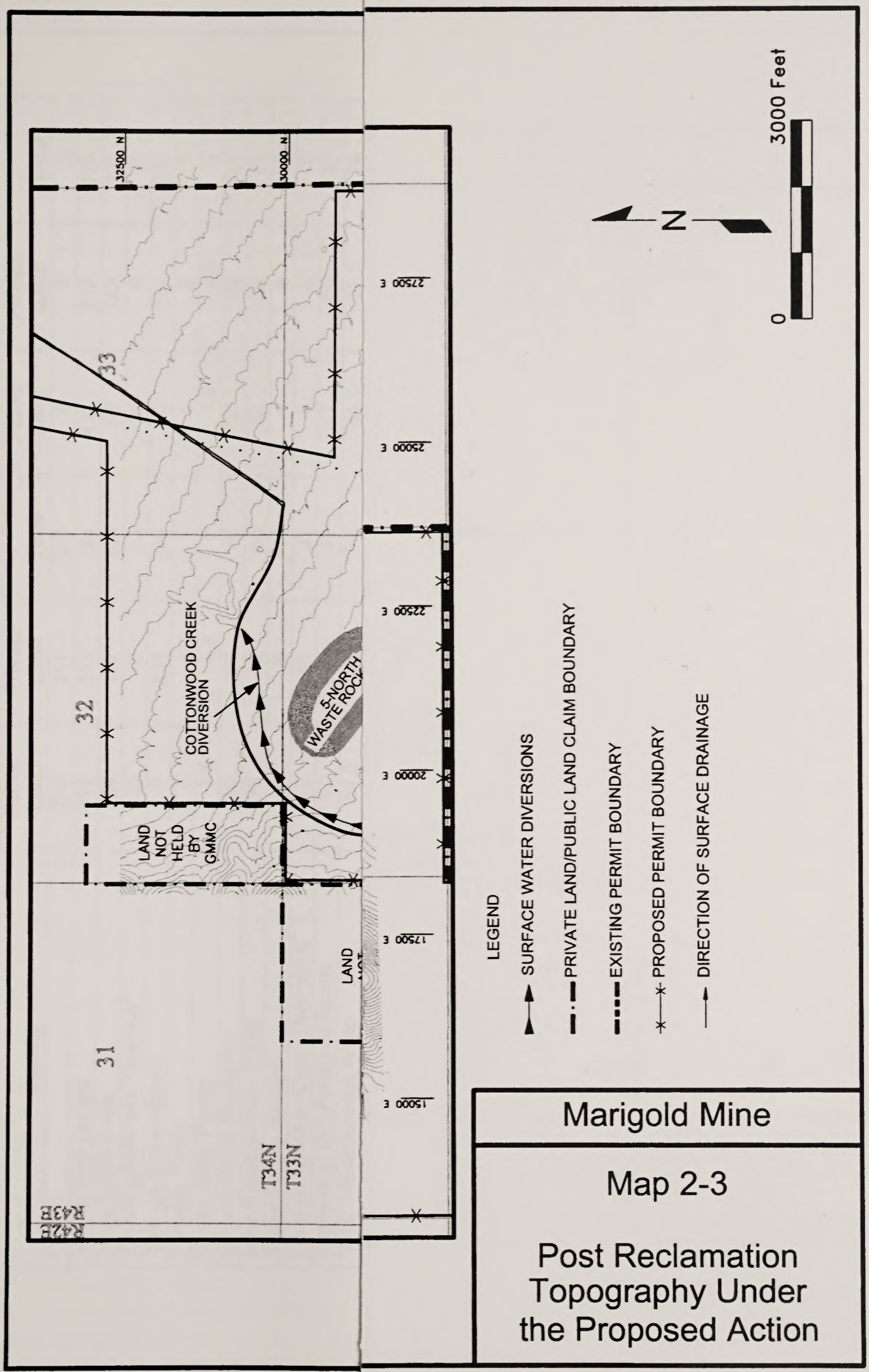
GMMC proposes to increase the authorized surface disturbance at the Marigold Mine from approximately 1,349 acres to approximately 2,063 acres. Most of the disturbance associated with the Proposed Action would result from the development of the 5-North and 8-North pits and associated waste rock dumps, development of the 5-North Heap Leach Pad, expansion of the Old Marigold and Resort waste rock dumps and the Red Rock and Top Zone pits, expansion of the Southwest Heap Leach Pad, and development of the new tailings impoundment, and "in-fill" areas. Reclamation would be both concurrent and post-use, following the plans currently approved for and utilized by GMMC at the existing operation. Post-mining topography for the Proposed Action is presented in Map 2-3. A summary of reclamation acreages by project facility is presented in Table 2-5.

***Approximately 656 acres of the 717 acres disturbed during proposed mining activities would be reclaimed after mine operations.***

A detailed Reclamation Plan has been submitted as part of the BLM Plan of Operations and NDEP Reclamation Permit. The reclamation approach and procedures were developed based on the site-specific conditions at the mine site. These procedures were designed so that the mining-related disturbance would be reclaimed to a productive use similar to the pre-mining land uses, and the reclaimed areas would be visually and functionally compatible with the surrounding topography.

The reclamation procedures currently used at the Marigold Mine incorporate seven basic components:

- Establishment of stable topographic surface and drainage conditions that would be compatible with the surrounding landscape and serve to control erosion;


32500 N
30000 N
27500 E
25000 E
22500 E
20000 E
17500 E
15000 E
33
32
31
COTTONWOOD CREEK DIVERSION
5-NORTH WASTE ROCK
LAND NOT HELD BY GMMC
T34N
T33N
R43E
R42E
N
0
3000 Feet
LEGEND
SURFACE WATER DIVERSIONS
PRIVATE LAND/PUBLIC LAND CLAIM BOUNDARY
EXISTING PERMIT BOUNDARY
PROPOSED PERMIT BOUNDARY
DIRECTION OF SURFACE DRAINAGE
Marigold Mine
Map 2-3
Post Reclamation Topography Under the Proposed Action

- Secondary effects to eligible sites resulting from road and drill pad construction and use would be minimized through the implementation of erosion control measures such as water bars, double sumps for drill water, and appropriate road design.

- If a previously undocumented archaeological site or subsurface components of documented sites are discovered during exploration, construction, operation, or reclamation activities, GMMC would cease activities in the area of the discovery until resources could be examined by a BLM-approved archeologist. If resources are identified as eligible for the National Register of Historic Places (NRHP), impacts would be mitigated through an appropriate treatment plan approved by the BLM, the State Historic Preservation Officer (SHPO), GMMC, and the Advisory Council, or through site avoidance.

- If significant fossiliferous deposits, specifically vertebrate fossil deposits, are located during exploration, construction, operation, or reclamation activities, ***the BLM*** would be notified, and measures would be taken to identify and preserve or avoid the fossils.

#### 2.2.18.8 Employee Environmental Education Program

GMMC currently provides environmental education for its employees. This training includes information on management practices incorporated into the operation of the facility to minimize impacts to the environment and ensure compliance with environmental permit criteria. This program would be continued throughout the operation of the Proposed Action. GMMC also is developing an operator's Environmental, Health, and Safety Compliance Handbook, in addition to maintaining detailed compliance schedules.

## 2.2.19 Reclamation

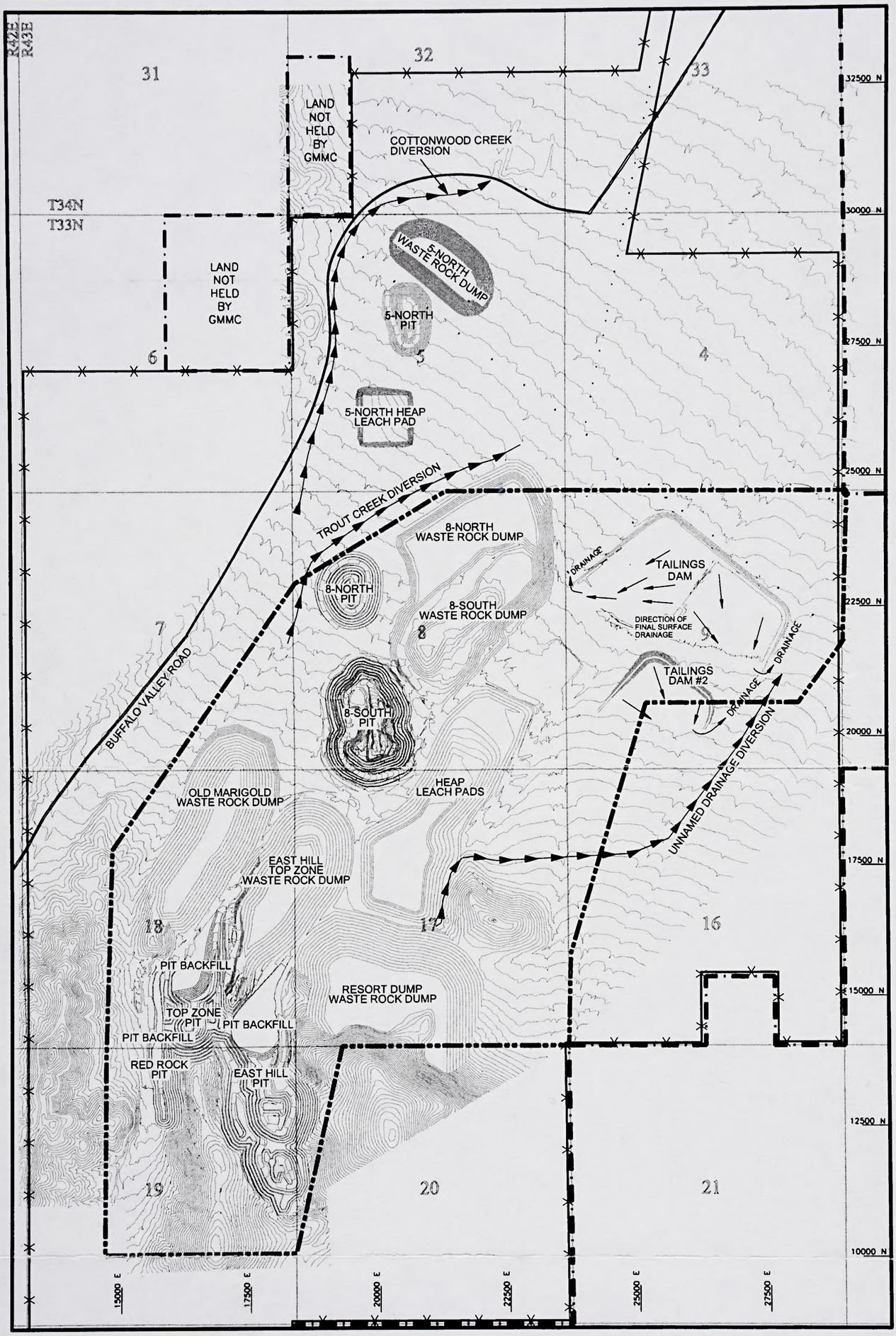
GMMC proposes to increase the authorized surface disturbance at the Marigold Mine from approximately 1,349 acres to approximately 2,063 acres. Most of the disturbance associated with the Proposed Action would result from the development of the 5-North and 8-North pits and associated waste rock dumps, development of the 5-North Heap Leach Pad, expansion of the Old Marigold and Resort waste rock dumps and the Red Rock and Top Zone pits, expansion of the Southwest Heap Leach Pad, and development of the new tailings impoundment, and "in-fill" areas. Reclamation would be both concurrent and post-use, following the plans currently approved for and utilized by GMMC at the existing operation. Post-mining topography for the Proposed Action is presented in Map 2-3. A summary of reclamation acreages by project facility is presented in Table 2-5.

***Approximately 656 acres of the 717 acres disturbed during proposed mining activities would be reclaimed after mine operations.***

A detailed Reclamation Plan has been submitted as part of the BLM Plan of Operations and NDEP Reclamation Permit. The reclamation approach and procedures were developed based on the site-specific conditions at the mine site. These procedures were designed so that the mining-related disturbance would be reclaimed to a productive use similar to the pre-mining land uses, and the reclaimed areas would be visually and functionally compatible with the surrounding topography.

The reclamation procedures currently used at the Marigold Mine incorporate seven basic components:

- Establishment of stable topographic surface and drainage conditions that would be compatible with the surrounding landscape and serve to control erosion;




LEGEND

- SURFACE WATER DIVERSIONS
- PRIVATE LAND/PUBLIC LAND CLAIM BOUNDARY
- EXISTING PERMIT BOUNDARY
- PROPOSED PERMIT BOUNDARY
- DIRECTION OF SURFACE DRAINAGE

N

0 3000 Feet

Marigold Mine

Map 2-3

Post Reclamation Topography Under the Proposed Action

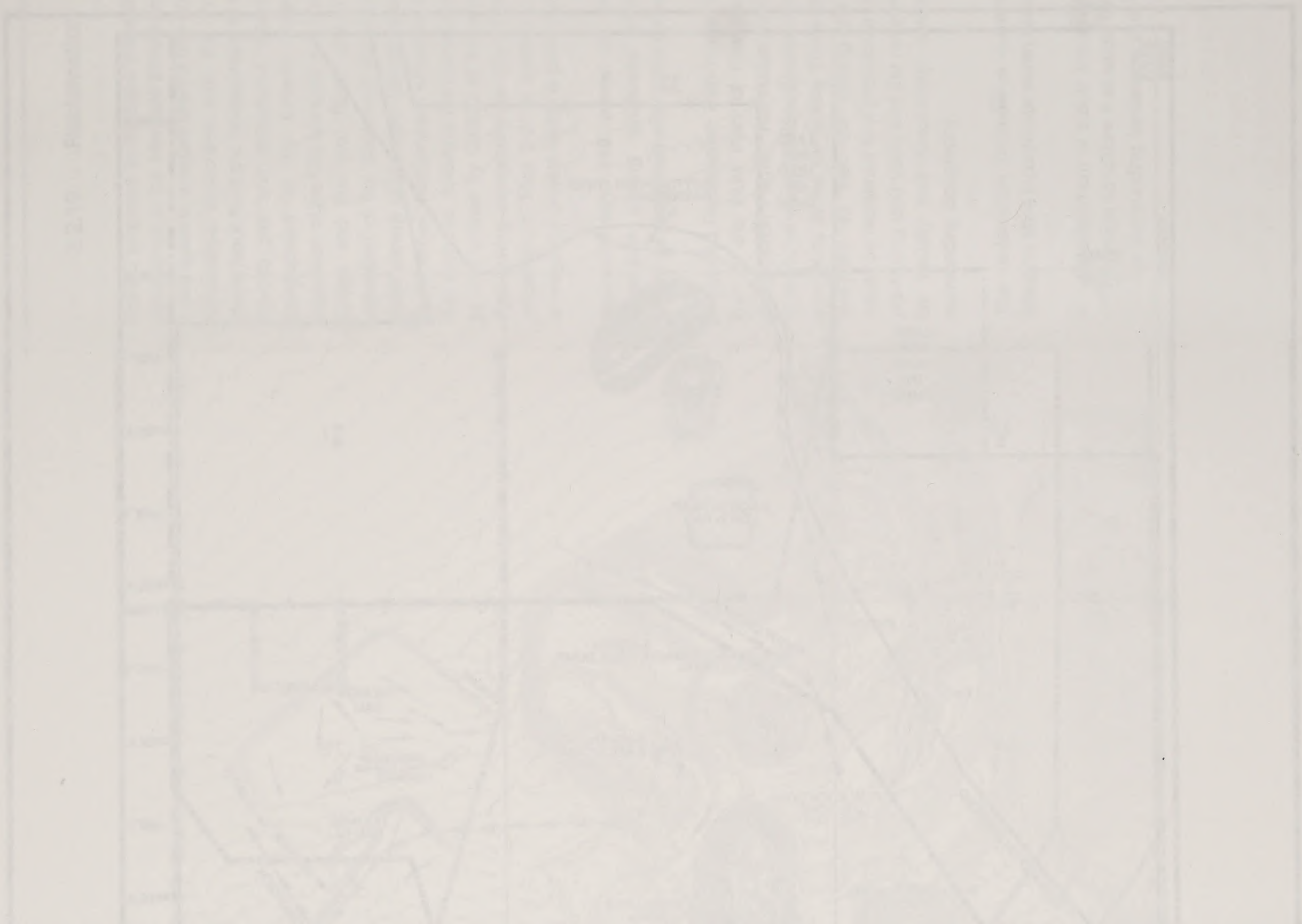


**Table 2-5**
**Acreages Disturbed and Reclaimed After the Proposed Action**

| Facility | Disturbed Acres[1] | | | Reclaimed Acres | | |
|---|---|---|---|---|---|---|
| | Public Land | Private Land | Total | Public Land | Private Land | Total |
| Pits | 324 | 211 | 535 | 0 | 0 | 0 |
| Waste Rock Dumps | 412 | 312 | 724 | 412 | 312 | 724 |
| Heap Leach Pads | 56 | 152 | 208 | 56 | 152 | 208 |
| Crushing/Mill/Plant Facilities[2] | 35 | 18 | 53 | 35 | 8 | 43 |
| Tailings Impoundment | 0 | 234 | 234 | 0 | 234 | 234 |
| Process Ponds | 5 | 2 | 7 | 5 | 2 | 7 |
| Storm Water Ponds | 1.5 | 4.5 | 6 | 1.5 | 4.5 | 6 |
| Growth Media Stockpiles | 10 | 38 | 48 | 10 | 38 | 48 |
| Haul Roads/Access Roads | 36 | 52 | 88 | 22 | 39 | 61 |
| Water Supply System | 4 | 9 | 13 | 4 | 9 | 13 |
| Diversion Ditches/Creek Diversions[3] | 13 | 18 | 31 | 0 | 0 | 0 |
| Exploration Drill Pads and Roads | 17 | 25 | 42 | 17 | 25 | 42 |
| "Infill"/Miscellaneous Areas | 51.5 | 22.5 | 74 | 51.5 | 22.5 | 74 |
| **Total Acreage** | **965** | **1,098** | **2,063** | **614** | **846** | **1,460** |

[1]Total of currently permitted and proposed disturbances.
[2]Although these facilities are not proposed to be reclaimed, the reclamation bond includes full reclamation cost estimates for these facilities.
[3]Diversions will be permanent features as part of the stabilization at facilities.

- Establishment of soil conditions most conducive to establishment of a stable plant community through stripping, stockpiling, and reapplication of suitable growth media;

- Revegetation of disturbed areas to establish a long-term productive biotic community compatible with proposed post-mining land uses;

- Reduction or elimination of potential environmental impacts;

  Consideration of public safety through stabilization, removal, and/or fencing of structures or landforms that could constitute a public hazard; and

- Consideration of the long-term visual character of reclaimed areas.

Revegetation success will be determined based on criteria outline in *Nevada Guidelines for Successful Revegetation for the Nevada Division of Environmental Protection, the Bureau of Land Management and the U.S.D.A. Forest Service* (BLM 1998).

#### 2.2.19.1 Growth Media Stockpiling and Use

Prior to development of the facilities under the Proposed Action, suitable growth media would be salvaged and stored in the five growth media stockpiles (Map 2-2). Suitable alluvial material also would be used to supplement the growth media. The stockpiles would be seeded with an interim seed mix to minimize wind and water erosion or invasion of noxious weeds.

#### 2.2.19.2 Grading and Stabilization

Following construction activity, slopes would be contoured in preparation for reclamation. Depending on the type of material, erodibility, and the practical considerations of the mining process, overall slope grades would range from near vertical to near-flat. After closure, the pit highwalls would be left in a stable configuration, subject to natural processes.

Final grading of cuts and fills in unconsolidated material would be conducted to create stable, undulating landforms to prevent pooling or ponding, and to blend with the surrounding undisturbed topography. Final grading would minimize erosion potential and additional surface disturbance, and would facilitate the establishment of post-mining vegetation.

#### 2.2.19.3 Surface and Seedbed Preparation

Prior to growth media application, disturbed areas would be inspected for slope stability, topographic diversity, surface water drainage capabilities, and compaction. Compacted surfaces would be loosened and left in a rough condition by ripping, followed by disking or other mechanical manipulation. Tillage implements may be used as needed for all areas to be reclaimed that could safely be worked by surface equipment to create a friable surface with favorable bulk density. Other grading and stabilization would be performed to ensure long-term stability. Growth media would then be distributed over the prepared surface to a depth of 6 to 12 inches. Soil amendments would be applied as needed, and the surface disked, raked, or treated to incorporate the amendments into the top 4 to 6 inches of growth media.

#### 2.2.19.4 Seed Mixtures and Rates

The proposed seed mixtures (Table 2-6) that would be used to revegetate disturbance areas are based on pre-mining vegetation and habitat types in the area, climatic and soil conditions of the project area, and seed availability. The final selection of seed mixes would depend on the results of site-specific reclamation studies and commercial availability of seed. Commercial seeds would be purchased from local sources, if possible.

**Table 2-6**
**Proposed Seed Mixes[1]**

| Scientific Name | Common Name | Seeding Rate (PLS lbs/acre)[2] | |
|---|---|---|---|
| | | Interim Seed Mix[3] | Reclamation Seed Mix |
| **GRASSES** | | | |
| *Agropyron desertorum* | Crested wheatgrass | 7.0 | 2.0 |
| *Sitanion hystrix* | Bottlebrush squirreltail | -- | 2.5 |
| *Oryzopsis hymenoides* | Indian ricegrass | -- | 2.5 |
| **FORBS** | | | |
| *Sphaeralcea coccinea* | Scarlet globemallow | -- | 0.5 |
| **SHRUBS** | | | |
| *Atriplex canescens* | Fourwing saltbush | -- | 3.0 |
| *Atriplex confertifolia* | Shadscale | -- | 3.0 |
| *Ceratoides lanata* | Winterfat | -- | 0.5 |
| **Total lbs/acre** | | ***7.0*** | 14.0 |

***[1]Seed would be tested for noxious weed seeds prior to application.***
[2]PLS = Pure live seed (pounds per acre).
[3]Soil stockpiles, road berms, and/or other temporary facilities.

Revegetation activities would be conducted in the fall to take advantage of winter moisture. On steep slopes and in rocky areas, broadcast seeding would be used for seed application. Drill seeding would be employed on level to gently sloping areas where coarse fragment content is low.

#### 2.2.19.5 Shrub Plantings

Native shrub seedlings would be planted on the tailings impoundment surface following application of growth media. This would be conducted in conjunction with seeding. GMMC is currently conducting a reclamation shrub study on the existing tailings impoundment to determine which species can be established on the tailings.

#### 2.2.19.6 Weed Control

Weed control measures would be implemented during vegetation establishment in order to limit the spread of noxious weeds and to ensure that the site is successfully reclaimed with desirable species. GMMC would coordinate noxious weed controls with the Nevada Department of Agriculture and the BLM, as appropriate. Noxious weed occurrences within the reclaimed areas would be reported to the BLM, and an appropriate eradication plan would be developed. If herbicides are used to control noxious weeds, the application rates and methods would conform to BLM standards thereby avoiding potential risks to human health.

#### 2.2.19.7 Reclamation Schedule

Reclamation would be initiated when individual process components are no longer required for mine operations or when facilities are decommissioned and site closure begins. Removal of facilities, rough grading, and scarifying activities may occur at any time during the project. Concurrent reclamation of select disturbed areas has been performed and may continue at any time until mine closure. Post-mining reclamation would be initiated when ore reserves have been exhausted and mining operations cease.

Soil distribution and revegetation activities are limited by the time of year during which they can be effectively implemented. General scheduling of revegetation activities would include:

- Grading, drainage control, and maintenance that would be conducted year-round;
- Seedbed preparation in early fall just prior to reseeding; and
- Completion of seeding prior to winter in order to take advantage of winter and spring moisture.

Figure 2-1 outlines the anticipated revegetation schedule, which would be followed during the life of the mine and 10 years beyond mine closure to achieve the reclamation goals. Site conditions and/or yearly climatic variations may require modifications to the revegetation schedule.

#### 2.2.19.8 Facility Reclamation

Reclamation procedures, as outlined in GMMC's currently approved POO/Reclamation Plan (RP) (Rayrock 1998) would be used for reclamation of the various components included in the proposed mine expansion. Reclamation of these facilities is discussed below.

**Open Pit**

The primary goal for reclamation of the open pits would be to ensure long-term stability of the final configurations. Pit walls would gradually ravel and sluff over time to the natural angle of repose for the individual rock types. Pit bottoms would be ripped and seeded to encourage absorption of precipitation. Reclamation of the near horizontal surfaces of the in-pit backfill would be similar to reclamation of the out-of-pit waste rock dumps. Growth media would be applied and the areas subsequently seeded with an appropriate seed mix. A perimeter berm with warning signs would be placed around the pits during reclamation with a sufficient setback to accommodate the projected, final pit crest.

Road beds in and around the pit areas and pit floors would be rebladed and ripped and/or scarified to prepare a seedbed or a surface for application of growth media; the area to be reclaimed would depend on engineering feasibility and safety considerations. The prepared surfaces would subsequently be seeded with an appropriate seed mixture.

**Drainage Diversions**

The proposed Trout Creek, Cottonwood Creek, and unnamed drainage diversions would remain in place after mining has been completed. These diversions have been designed to return the stream flows to the original channels downstream of the developed facilities and prevent water from accumulating in the pit bottoms. Remedial activities associated with these diversions is expected to include removal of any installed culverts, remedial earthwork, revegetation of disturbed areas, and armoring sections of the diversion channels with rock to reduce erosion, as needed. ***GMMC will submit engineered design reports to BLM for review and concurrence, prior to initiating construction of the drainage diversions. Based on these reports, the BLM and NDEP would determine the appropriate bond amount, taking into consideration long-term monitoring costs, channel maintenance expense, and sufficient funding for the complete reconstruction of the diversions.***

**Waste Rock Dumps**

Prior to reclamation, the waste rock dumps would be recontoured, regraded to slope angles of 3H:1V, and crowned to prevent water from ponding. Perimeters would be irregular to allow blending with the existing topography. Large boulders would be placed on the ridges or benches to provide wildlife habitat. All flat benches and other areas of the dump with recontoured slopes accessible by heavy machinery would be ripped and/or scarified to produce a rough surface for anchoring of reapplied growth media. Growth media would be applied to the sideslopes as well as the top surfaces of the waste rock dumps. These areas would be reseeded with an appropriate seed mixture.

**Ore Crushing and Processing Facilities**

Crusher and mill facilities would be decommissioned following the completion of ore processing. Equipment, electrical facilities, instrumentation, aboveground piping, miscellaneous fencing, and mobile and permanent structures would be removed from the site in accordance with appropriate Federal and state regulations. Foundations would be broken up and buried in place prior to growth media application and seeding.

**Heap Leach Pads**

Permanent closure of the heap leach facilities would require treatment of the spent heaps to neutralize the weak acid dissociable (WAD) cyanide available in the ore pile and to lower the pH. GMMC would utilize one of three methods for heap leach pad closure, depending upon results from rinse tests and MWMP tests to identify contaminants that would require neutralization in the heaps. These methods would include:

- A freshwater rinse with chemical neutralization and/or carbon filtration;
- An expanded freshwater rinse with bacterial neutralization and a passive bioreactor; and
- The Greenworld Science Method of heap closure.

Under the freshwater rinse with chemical neutralization method, neutralization would be accomplished by rinsing the heaps with fresh water. It is anticipated that the application rate of fresh water would be similar to the operational leaching rate of 2,000 gpm. Treatment of the rinseate would include chemical neutralization and/or carbon filtration. Rinsing of the heaps would continue until the rinseate is successfully neutralized as determined by the NDEP, Regulation Branch and BLM.

The neutralized heaps would be regraded to a final average slope of 3H:1V. Perimeter berms and ditches would be left intact and covered during regrading. All surface plumbing and exposed conduit would be removed and disposed of properly. The liner and drain pipes would be left in place under the stabilized heap. The heaps would be resurfaced with growth media and seeded with an appropriate seed mix.

The second method of heap leach neutralization, a freshwater rinse with bacterial neutralization is currently employed at the REN Mine in Nevada and could be utilized at the Marigold Mine. Under this alternative, the surface area of the leach pads would be expanded and collection ditches installed on the outside of the expanded pad areas. The expanded pad areas would be compacted, covered with low permeability natural materials, and a synthetic liner and leak detection/collection system would be installed to connect with the present liner and system. After the spent heaps have been sprayed with fresh water to reduce the level of cyanide, the heaps would be distributed over the expanded pads to facilitate an overall slope angle of less than 3H:1V. The heaps would be seeded with a reclamation seed mix (see Table 2-6) in order to promote bacterial growth and subsequently neutralize the heap. Periodic rinsing with fresh water would promote the vegetative and bacterial growth. A passive bioreactor, which acts similarly to a sewage treatment leach field, would be used to treat the rinseate. Periodic rinsing of the heaps would continue until the rinseate was successfully neutralized. Final reclamation of the neutralized heaps would proceed, as discussed above, pending BLM and NDEP review and approval.

The third potential heap leach pad closure method, the Greenworld Science Method, is currently in use at the Glamis Dee Gold Mine in Eureka County, Nevada. This method involves a proprietary chemical/nutrient treatment using a combination of alcohols, sugars, or fatty acids to create a reducing environment in the heap. The nutrients are injected into the heap subsurface, as soon as active heap operations have ceased, to deoxygenate the heap and form bio-reductive zones for the precipitation of reducible species from solution. Using this methodology, cyanide, nitrate/nitrites, and metal constituents can be altered or immobilized in the

heap. After chemical treatment, the slopes would be reduced, and a 6-inch evapotranspiration cover composed of soil would be applied. The drain down solutions would be land-applied in a constructed leach field. The associated leach ponds would be closed and reclaimed. This treatment, combined with the soil cover, would ensure that drinking water standards would be met for all constituents except salts and total dissolved solids. These elements would be removed using a simple leach field unit process. The expanded freshwater rinse with bacterial neutralization and the Greenworld Science Method heap leach neutralization processes will require additional NEPA analysis to determine impacts and must be approved by both BLM and NDEP prior to the initiation of these neutralization methods.

GMMC would be responsible for monitoring seepage control and effluent for up to 3 years, as directed by NDEP, to meet Nevada drinking water standards. ***The final selection of the leach pad reclamation method would be made at mine closure by NDEP, GMMC, and the BLM, and would be dependent on several variables, including rinseate quality, and residual draindown quality and quantity. Once these variables have been determined, a final closure method would be selected, analyzed, and disclosed through the NEPA process. BLM's closure policy and guidelines for heap leach facilities has been provided in Appendix A.***

**Process Solution Ponds**

Reclamation of the process solution ponds and water storage ponds would consist of draining, removal or burial in place of the synthetic liners, reshaping, seedbed preparation, and seeding. Following evaporation of all liquid from the ponds, any sludges in the ponds would be analyzed using both the MWMP and the Toxicity Characterization Leaching Procedure (TCLP). If the results are within the limits as defined by each procedure, the synthetic liners would be folded around the evaporate and buried in-place ***5 feet below the surface. If the limits are exceeded, the synthetic liners and evaporate would be removed and disposed of in an approved hazardous waste facility by an approved hazardous waste contractor.***

All pond sites and ditches would be filled and recontoured to prevent ponding of runoff and allow for natural drainage. The pond areas would be graded and contoured to blend in with the natural topography. The prepared surfaces would be scarified and reseeded.

**Tailings Impoundment**

During operations, the proposed tailings dam slopes would be revegetated to minimize erosion of the structure. Revegetation would occur on the additional lift to be added to the existing impoundment dam and on any additional disturbance on the existing embankment. Growth media would be applied and work would be conducted concurrently (i.e., during the life of the facility).

Upon cessation of mining and after placement of waste rock and growth media on the tailings, any ongoing seepage would be continually pumped back to the tailings impoundment and used to promote the establishment of the vegetative cover and to control dust during the drying process. All remaining tailings solutions would be evaporated.

Drying of the tailings would be expedited by establishing a shrub cover to enhance evapotranspiration. Test plots would be constructed to determine if one or more of the following salt tolerant species can be established on the tailings: black greasewood (*Sarcobatus vermiculatus*), quailbush (*Atriplex lentiformis*), desert willow (*Chilopsis linearis*), or other species approved by the BLM. These species would be in addition to the species previously tested and established by GMMC on the existing tailings impoundment.

Tailings material would be analyzed using both MWMP and TCLP tests. If results meet regulatory requirements, the material would be stabilized in place. If not, an alternative closure plan would be

developed with NDEP. The planned 3-year shutdown of the mill also would provide additional time to evaluate the tailings remediation program currently in place at the Marigold Mine.

Reclamation of the tailings impoundment would be conducted as follows:

- Diversion ditches installed during construction of the impoundment would be retained, or new ditches constructed, to prevent storm water run-on.

- All surface plumbing, dewatering sumps, and exposed conduits would be removed and disposed of appropriately. The impoundment liner and drain pipes would be left in place under the stabilized pond. Wells, would be plugged according to State of Nevada standards.

- The dam roadway surface and any excess dike material would be bulldozed onto the tailings pond area. The tailings surface would be regraded to allow positive drainage and prevent ponding. The tailings pond surface would be recontoured, where necessary, to allow drainage away from the tailings dam.

- The regraded pond surface would be covered with a minimum of 1 foot of waste rock to cover the tailings, followed by 6 inches of growth media. After placement of the growth media, the seedbed would be prepared and the surface seeded.

- In addition to broadcasting seed, native shrub seedlings would be planted after the seedbed had been prepared.

- Interceptor ditches at the base of the dam (consisting of buried 4-inch diameter pipe) would 7be end capped, and minor regrading would be conducted to ensure adequate burial of the pipe and the collection box.

- All ancillary equipment associated with the impoundment facility would be removed. Cement foundations would be broken up and buried in place.

- Tailings effluent captured by the TSPS would be used to control fugitive dust emissions from the tailings impoundment and to promote vegetation establishment within the tailings impoundment.

**Roads, *Drill Pads, and Sumps***

All roads, ***drill pads, and sumps*** within the project area would be ripped, scarified, and revegetated, following the completion of mining, unless designated as a county road. Roads would be contoured as near as possible to the surrounding terrain. All culverts and other water diversion structures would be removed and the natural drainage patterns restored. Water bars or other structures may be left in place to reduce any undue erosion. The prepared surfaces would be seeded with an appropriate seed mix.

**Removal of Stored Fuels, Chemicals, and Blasting Supplies**

Fuels, chemicals, and blasting supplies would be consumed prior to the end of mining, if feasible. Remaining inventories would be returned to vendors or removed and properly disposed of off-site.

**Exploration Drill Hole Abandonment**

All exploration drill holes completed after April 9, 1990, have been plugged according to standards stipulated by the NRS 534.421 through NRS 534.428. Any additional drill holes resulting from ongoing exploration also would be plugged according to these requirements.

**Ancillary Facilities**

Prior to decommissioning of mine facilities, GMMC would submit a detailed decommissioning plan to NDEP for approval. Structures would be properly removed and/or buried. Following removal or burial,

the ground surface would be recontoured, prepared, and seeded. Disposition of other project components on public grounds would consist of:

- Freshwater rinsing or active treatment of any piping which contained cyanide solutions;
- Concrete foundations would be broken-up and buried in place;
- Buried piping and conduits would be drained, rinsed, capped or sealed, as needed, and buried in place;
- Scrap metal, trash, and other non-hazardous debris would be placed in the existing Class III landfill or disposed of off-site at an appropriate facility; and
- All power lines and electrical systems not required for future post-mining use would be removed.

**Facilities Not Reclaimed**

The following components would not be subject to post-mining reclamation:

- Main access road from the Buffalo Valley Road;
- Certain buildings and structures located on private property in Section 9;
- Electric power lines or equipment necessary for post-mining uses; and
- Water lines or other utilities required for post-mining uses.

## 2.3 8-South Partial Pit Backfill Alternative

The 8-South Partial Pit Backfill Alternative would include the partial backfilling of the existing 8-South Pit with approximately 16.5 million tons of waste rock originating from the proposed 8-North Pit (Map 2-4). This alternative would eliminate the need to construct the 8-North Waste Rock Dump (85 acres) thereby decreasing total disturbance to 632 acres. In addition, the partial backfilling of the pit would eliminate the potential formation of a shallow pit lake after mine closure. A summary of total disturbance and reclamation acreages is presented in Table 2-7. Post-reclamation topography for the alternative is illustrated in Map 2-5. All other aspects of mine operation under this alternative would be the same as described for the Proposed Action.

## 2.4 No Action Alternative

Under the No Action alternative, currently permitted operations at the Marigold Mine would cease after 2001, with final reclamation extending 10 years beyond closure. Additional mineral resources in the project area would remain undeveloped, and no construction or expansion of mine pits, waste rock dumps, heap leach pads, tailings impoundment, or other ancillary facilities would occur. It is estimated that the seepage period for the existing tailings impoundment would be reduced by 3 to 5 years under this Alternative. A summary of reclamation acreages by project facility for the No Action Alternative is presented in Table 2-8. Post-reclamation topography for this alternative is illustrated in Map 2-6.

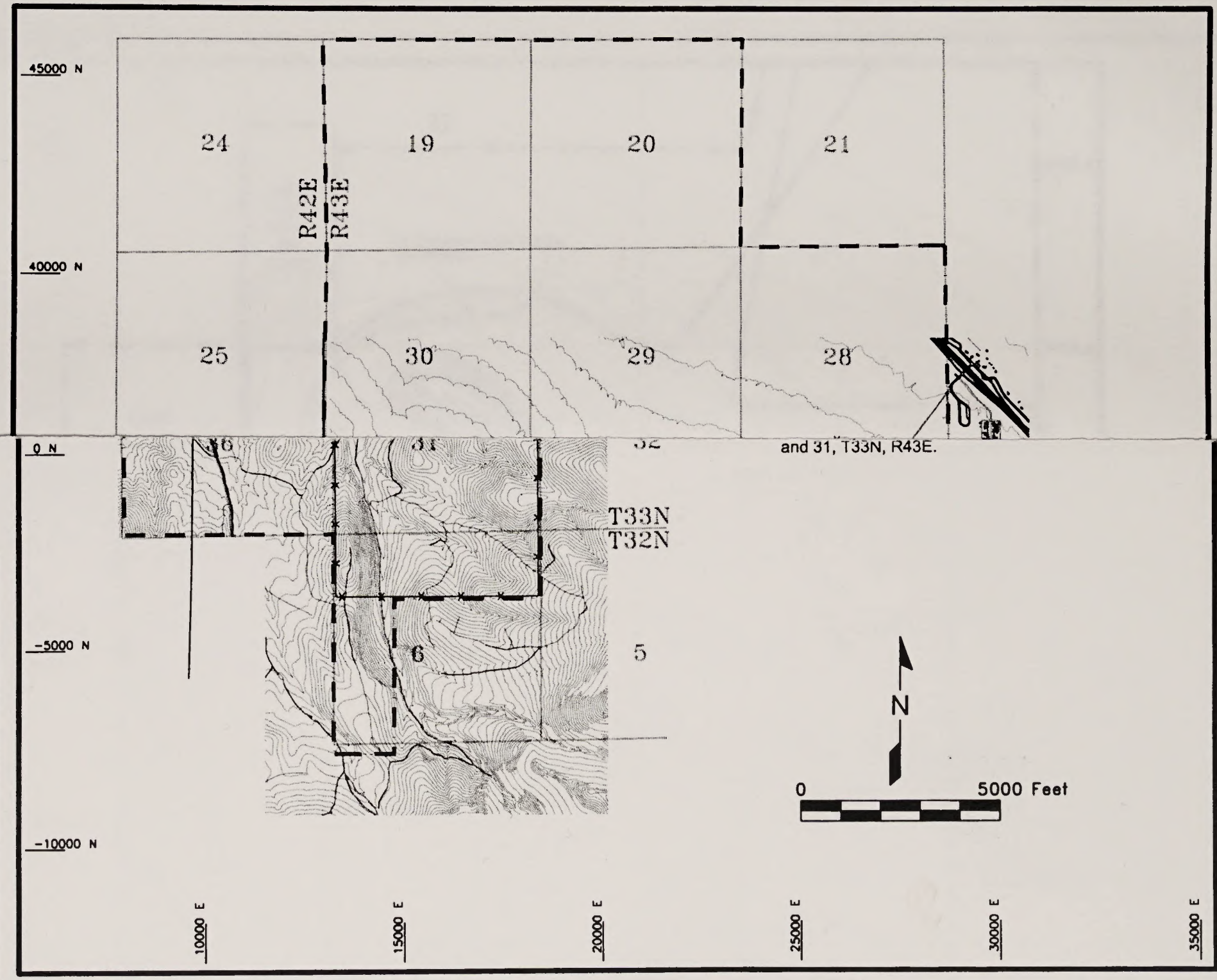
## 2.5 Alternatives Considered but Eliminated from Detailed Analysis

GMMC considered alternative sites for waste rock dumps and heap leach facilities. Based on condemnation drilling, haul distances, drainage patterns, and operational flexibility, these alternatives were eliminated from detailed analysis. These alternatives included:

- Relocation of 5-North Waste Rock Dump to east of the proposed 5-North Pit;

LEGEND

- WASTE ROCK DUMPS
- MINE PITS
- GROWTH MEDIA STOCKPILES
- PROCESS FACILITIES
- FACILITIES, HAUL ROADS, "INFILL" AREAS, ETC.
- SURFACE WATER DIVERSIONS
- PRIVATE LAND/ PUBLIC LAND CLAIM BOUNDARY
- EXISTING PERMIT BOUNDARY
- PROPOSED PERMIT BOUNDARY




Marigold Mine

Map 2-4

8-South Partial Pit
Backfill Alternative

the ground surface would be recontoured, prepared, and seeded. Disposition of other project components on public grounds would consist of:

- Freshwater rinsing or active treatment of any piping which contained cyanide solutions;
- Concrete foundations would be broken-up and buried in place;
- Buried piping and conduits would be drained, rinsed, capped or sealed, as needed, and buried in place;
- Scrap metal, trash, and other non-hazardous debris would be placed in the existing Class III landfill or disposed of off-site at an appropriate facility; and
- All power lines and electrical systems not required for future post-mining use would be removed.

**Facilities Not Reclaimed**

The following components would not be subject to post-mining reclamation:

- Main access road from the Buffalo Valley Road;
- Certain buildings and structures located on private property in Section 9;
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- Water lines or other utilities required for post-mining uses.

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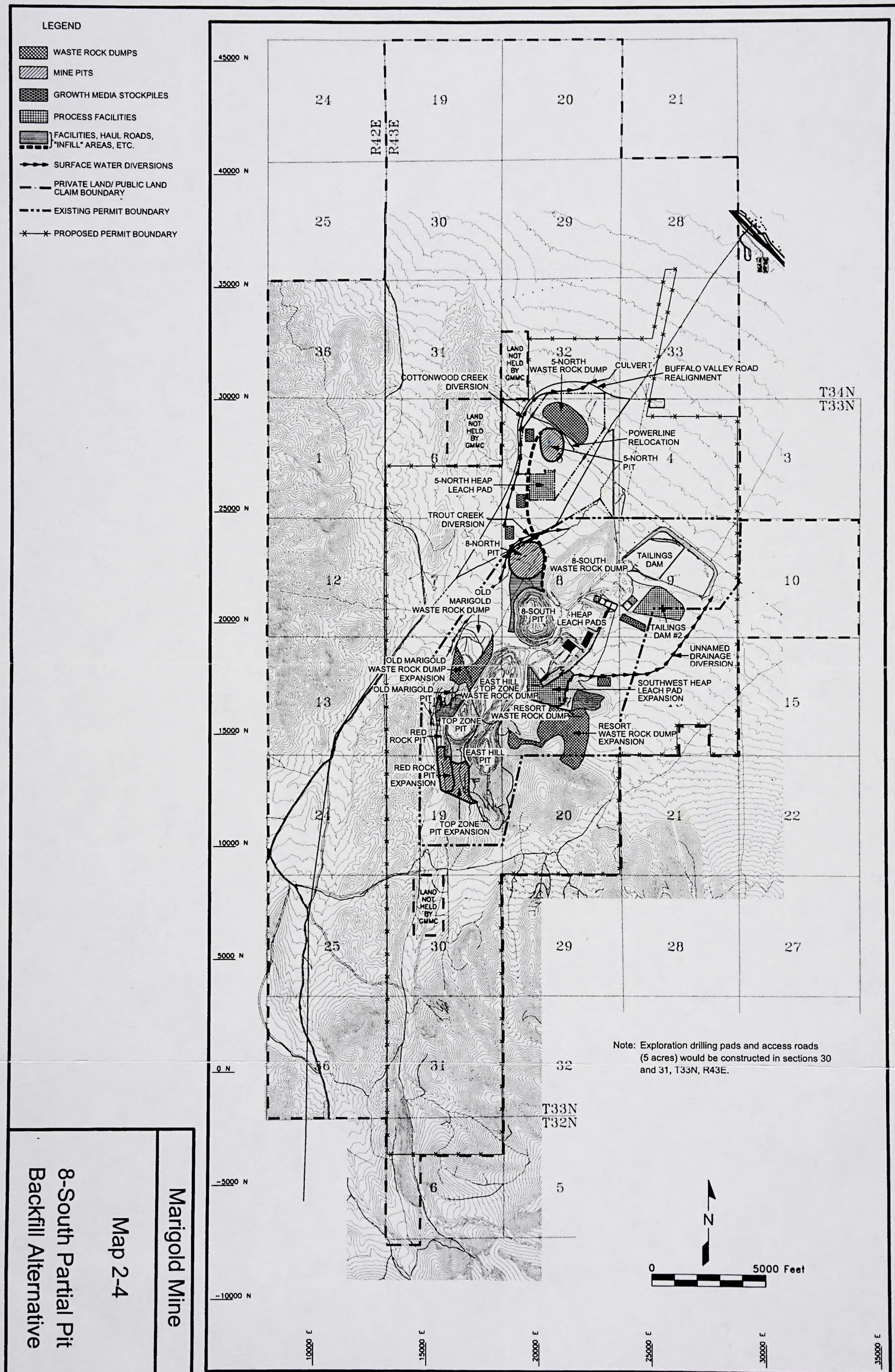
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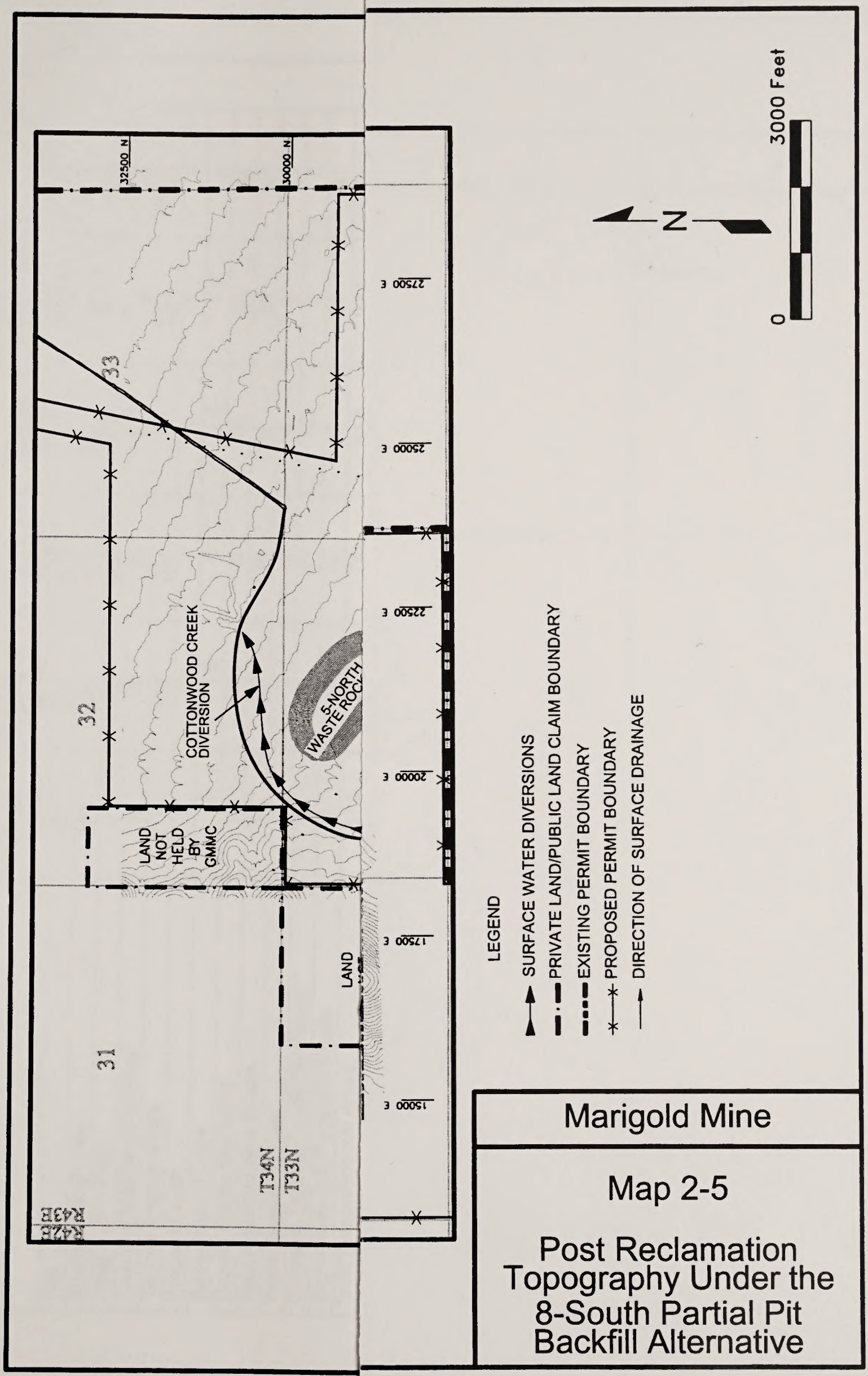
- Relocation of 5-North Waste Rock Dump to east of the proposed 5-North Pit;




Marigold Mine

Map 2-4

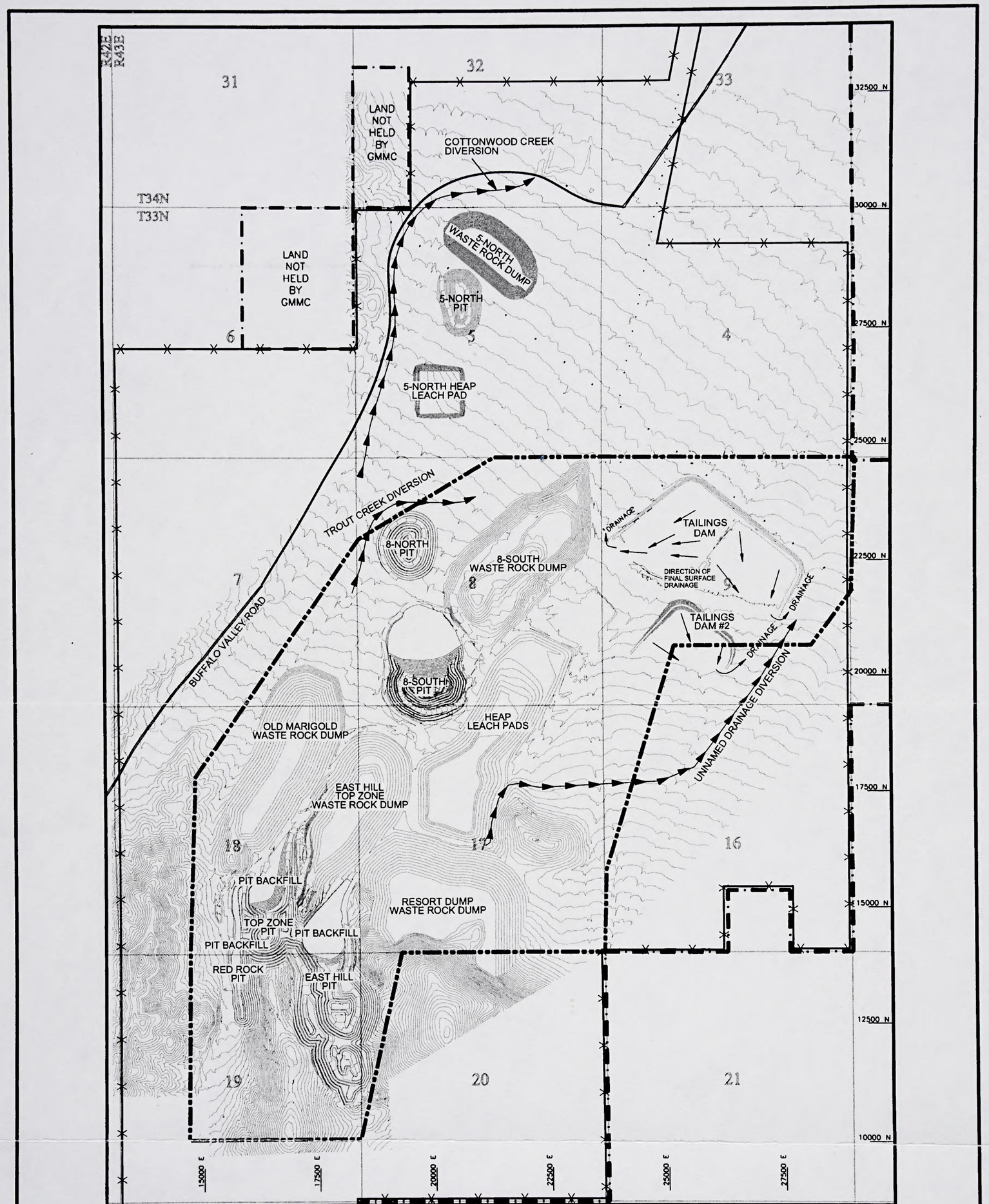
8-South Partial Pit Backfill Alternative




# Marigold Mine

## Map 2-5

## Post Reclamation Topography Under the 8-South Partial Pit Backfill Alternative




LEGEND

- SURFACE WATER DIVERSIONS
- PRIVATE LAND/PUBLIC LAND CLAIM BOUNDARY
- EXISTING PERMIT BOUNDARY
- PROPOSED PERMIT BOUNDARY
- DIRECTION OF SURFACE DRAINAGE

N

0 3000 Feet

Marigold Mine

Map 2-5

Post Reclamation Topography Under the 8-South Partial Pit Backfill Alternative



**Table 2-7**
**Acreages Disturbed and Reclaimed After the 8-South Partial Pit Backfill Alternative**

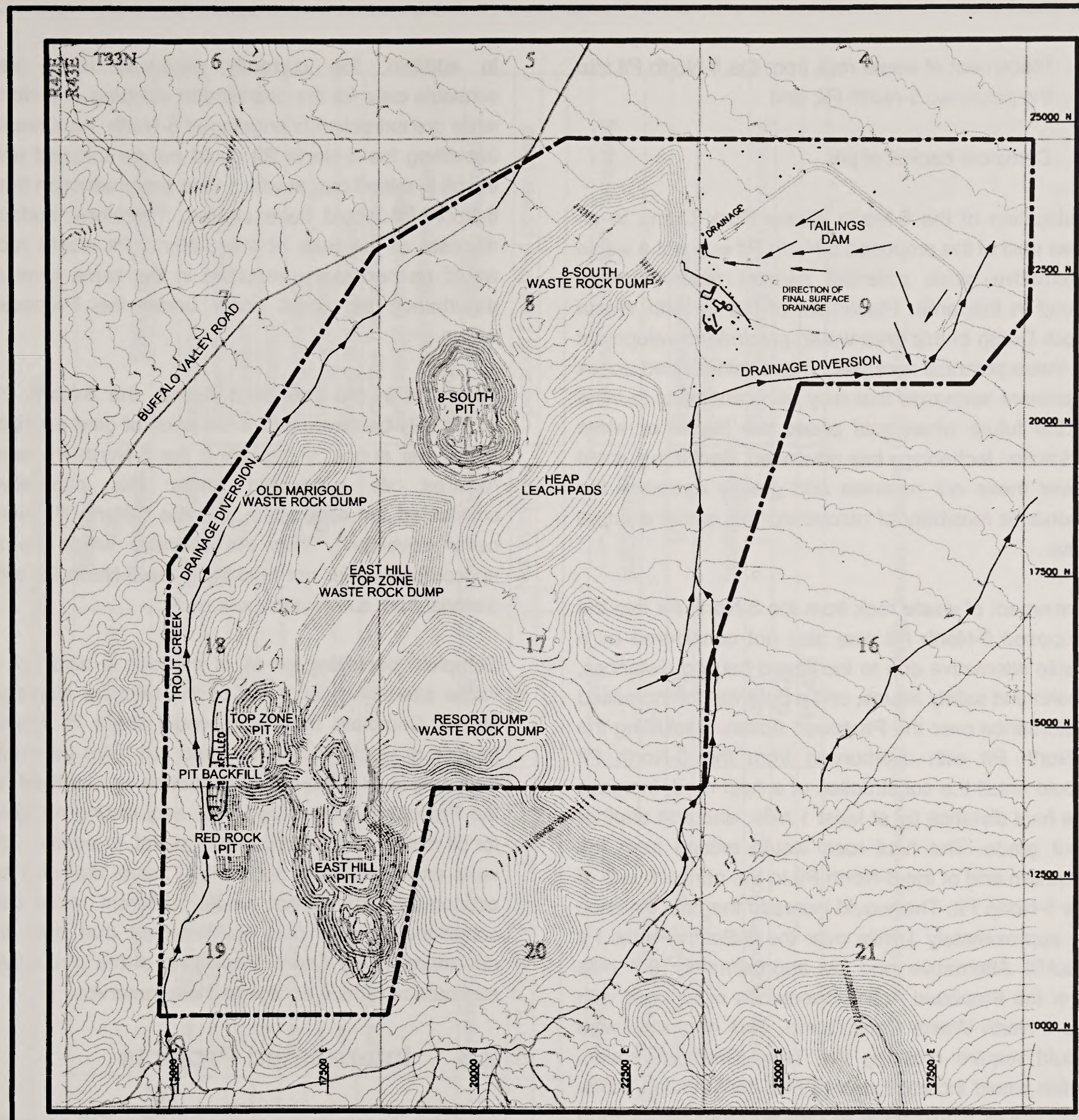
| Facility | Disturbed Acres[1] | | | Reclaimed Acres | | |
|---|---|---|---|---|---|---|
| | Public Land | Private Land | Total | Public Land | Private Land | Total |
| Pits | 324 | 211 | 535 | 0 | 0 | 0 |
| Waste Rock Dumps | 343 | 296 | 639 | 343 | 296 | 639 |
| Heap Leach Pads | 56 | 152 | 208 | 56 | 152 | 208 |
| Crushing/Mill/Plant Facilities[2] | 35 | 18 | 53 | 35 | 8 | 43 |
| Tailings Impoundment | 0 | 234 | 234 | 0 | 234 | 234 |
| Process Ponds | 5 | 2 | 7 | 5 | 2 | 7 |
| Storm Water Ponds | 1.5 | 4.5 | 6 | 1.5 | 4.5 | 6 |
| Growth Media Stockpiles | 10 | 38 | 48 | 10 | 38 | 48 |
| Haul Roads/Access Roads | 36 | 52 | 88 | 22 | 39 | 61 |
| Water Supply System | 4 | 9 | 13 | 4 | 9 | 13 |
| Diversion Ditches/Creek Diversions[3] | 13 | 18 | 31 | 0 | 0 | 0 |
| Exploration Drill Pads and Roads | 17 | 25 | 42 | 17 | 25 | 42 |
| "Infill"/Miscellaneous Areas | 51.5 | 22.5 | 74 | 51.5 | 22.5 | 74 |
| **Total Acreage** | **896** | **1,082** | **1,978** | **545** | **830** | **1,375** |

[1]Total of currently permitted and proposed disturbances.
[2]Although these facilities are not proposed to be reclaimed, the reclamation bond includes full reclamation cost estimates for these facilities.
[3]Diversions will be permanent features as part of the stabilization at facilities.

**Table 2-8**
**Acreages Disturbed and Reclaimed After the No Action Alternative**

| Facility | Disturbed Acres[1] | | | Reclaimed Acres[2] | | |
|---|---|---|---|---|---|---|
| | Public Land | Private Land | Total | Public Land | Private Land | Total |
| Pits | 272 | 132 | 404 | 35 | 10 | 45 |
| Waste Rock Dumps | 292 | 148 | 440 | 292 | 148 | 440 |
| Heap Leach Pads | 56 | 74 | 130 | 56 | 74 | 130 |
| Crushing/Mill/Plant Facilities | 35 | 17 | 52 | 35 | 17 | 52 |
| Tailings Impoundment | 0 | 180 | 180 | 0 | 180 | 180 |
| Process Ponds | 5 | 0 | 5 | 5 | 0 | 5 |
| Storm Water Ponds | 1.5 | 1.5 | 3 | 1.5 | 1.5 | 3 |
| Growth Media Stockpiles | 5 | 15 | 20 | 5 | 15 | 20 |
| Haul Roads/Access Roads | 22 | 38 | 60 | 22 | 38 | 60 |
| Water Supply System | 4 | 9 | 13 | 4 | 9 | 13 |
| Diversion Ditches/Creek Diversions[3] | ~0.1 | 3 | 3 | 0 | 0 | 0 |
| Exploration Drill Pads and Roads | 17 | 20 | 37 | 17 | 20 | 37 |
| "Infill"/Miscellaneous Areas | 1.5 | 0.5 | 2 | 1.5 | 0.5 | 2 |
| **Total Acreage** | **711** | **638** | **1,349** | **474** | **513** | **987** |

[1]Currently permitted disturbances only.
[2]Actual acreage may vary depending on level of backfill conducted.
[3]Diversions will be permanent features as part of the stabilization at facilities.




LEGEND

- SURFACE WATER DIVERSIONS
- PROJECT BOUNDARY
- DIRECTION OF SURFACE DRAINAGE

N

0 3000 Feet

# Marigold Mine

## Map 2-6

## Post Reclamation Topography For the No Action Alternative

- Placement of waste rock from the 8-North Pit into the proposed 5-North Pit; and

- Complete backfill of pits.

Relocation of the 5-North Waste Rock Dump to an area east of the proposed 5-North Pit was not a viable alternative since potential mineral reserves were found in this area. Placement of the 5-North Waste Rock Dump in this area would preclude development of these potential reserves. These mineralized zones represent resources that may be economical to mine in the future when gold prices are higher or when extraction technology has advanced. Backfilling would cover these ore reserves and greatly decrease the economic feasibility of recovering this ore at a future date.

Placement of waste rock from the 8-North Pit into the proposed 5-North Pit was also not considered as a viable alternative due to increased hauling distances, health and safety issues, and a potential for increased disturbance over the Proposed Action. Backfilling the 5-North Pit with overburden from the 8-North Pit would entail the construction of a haul road, increase the haul distance by at least 1 mile, and add another haul grade. The haul road would extend from the southern end of the 8-North Pit to the northern end of the 5-North Pit. This would increase the haul distance by approximately 1 mile over the 8-South Partial Pit Backfill Alternative and by approximately 0.7 mile over the Proposed Action operations associated with the 8-North Waste Rock Dump. This haul road also would require crossing the Trout Creek diversion, which would increase design and construction costs. Haul trucks would have to descend into the 5-North Pit to dump, increasing the potential for accidents and fugitive dust and other air quality issues. The haul trucks would also need to ascend from the 5-North Pit, increasing the haul grade over that occurring under the Proposed Action. The increased hauling distance would increase the cost of production for 8-North ore, thereby reducing the tonnage of ore that could be economically extracted from the 8-North Pit.

In addition, the currently proposed mine plan schedule calls for the overburden stripping of 8-North while ore extraction is ongoing at 5-North. As a result, backfilling the 5-North Pit could not be initiated until the pit is mined out, at which time ore production from 8-North Pit would have started. Therefore, surface disposal of the bulk of the 8-North Pit waste rock would be necessary, resulting in the same level of disturbance as would occur under the Proposed Action.

As stated in the Proposed Action, the 8-North Pit would only be developed if the price of gold exceeds $400+ per ounce. If backfilling the 5-North Pit were required, as suggested under this alternative considered but eliminated, and the 8-North Pit were never developed, then the operator would be in noncompliance for not backfilling the 5-North Pit with material from a non-viable ore body.

Complete backfilling of all of the pits is also not a viable alternative for many of the reasons identified above. Complete backfilling would result in double hauling of waste rock and would still have generally the same level of surface disturbance as identified for the Proposed Action due to the sequencing required for pit mining and overburden removal. In addition, pit walls and floors have mineralized zones that may be economical to extract under different economic conditions or with new technologies that may be developed in the future. Backfilling of the pits would eliminate or reduce access to these reserves.

## 2.6 Interrelated Projects

Interrelated projects are defined for this EIS as those activities that have impacts which, when combined with impacts of the proposed project, could result in cumulative effects on the environment. Interrelated projects include past, present, and reasonably foreseeable future actions. Table 2-9 lists the past and present actions, Proposed Action, and reasonably foreseeable future actions in the Marigold Mine cumulative assessment area. Resource-specific

**Table 2-9**
**Interrelated Projects in the Marigold Mine Cumulative Assessment Area**

| Facility Name | Company | Disturbance Acreage | Number Of Employees | Status or Comments |
|---|---|---|---|---|
| **PAST AND PRESENT ACTIONS** | | | | |
| Brass Ring Exploration | Brass Ring Resources | 18 | Not available | Exploration |
| Buffalo Mountain Exploration | Newmont Gold Co. | 18 | Not available | Reclamation activity only |
| Buffalo Valley Mine | Fairmile Gold | 146 | NA | Exploration |
| Converse Exploration Project | Uranerz USA, Inc. (Cameco) | 50 | Not available | Exploration |
| Lone Tree Mine | Newmont Gold Co. | 4,730 | 350 | Mining operation |
| Marigold Mine | Glamis Gold, Inc. | 1,349 | ***100*** | Mining operation |
| Reona Project | Battle Mountain Gold Co. | 2,704 | 20 | Mining and exploration |
| Trenton Canyon Mine | Newmont Gold Co. | 2,682 | 130 | Includes Trenton Canyon Exploration Consolidation disturbance within mine plan boundary |
| Trenton Canyon Exploration Consolidation | Newmont Gold Co. | 696 | Not available | Exploration drill sites and roads |
| North Valmy Power Station | Sierra Pacific Power Co. | NA | Not available | Operating coal-fired power plant |
| **Subtotal** | | 12,393 | | |
| **PROPOSED ACTION** | | | | |
| Marigold Mine | GMMC | 717 | ~37 (additional) | Proposed mining and processing |
| **REASONABLY FORESEEABLE FUTURE ACTIONS** | | | | |
| Lone Tree Mine | Newmont Gold Co. | 50 | 100 | Modification to Plan |
| Marigold Mine | Glamis Gold, Inc. | 1,174 | 15 (additional) | Future expansion |
| Phoenix Project | Battle Mountain Gold Co. | 4,387 | 210 | Proposed mining and processing |
| **Subtotal** | | **6,325** | | |
| **TOTAL** | | **19,435** | | |

NA = Not applicable.

Sources: Brown and Caldwell 1999; BLM 1999; American Mines Handbook 1999; Western Mining Directory 1998; JBR 1998; BLM 1998.

cumulative assessment areas were developed for each resource, as appropriate, and are discussed under their respective sections in Chapter 3.0. The locations of interrelated projects are illustrated on Map 2-7. Descriptions of the projects are provided in the following sections.

As defined in 40 CFR 1508.7 (regulations for implementing NEPA), a cumulative impact is an impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or entity undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time. BLM Instruction Memo NV-90-435 specifies that impacts must first be identified for the proposed project before cumulative impacts with interrelated projects can occur.

Interrelated projects with the potential for cumulative impacts were identified based on the type of activity, geographic location, and time period. A brief description of these actions is provided in this section. The area of concern for cumulative impacts varies by resource, with impacts to certain resources being restricted to the actual area of disturbance. The cumulative assessment area for many resources encompasses an area within a few miles or less of the proposed project site. Exceptions are the cumulative assessment area for cultural resources (includes all major mining projects located between I-80 south to the county line and east from the Lone Tree area to I-80), socioeconomics (includes three-county area), and range/soils/vegetation resources (Battle Mountain Range).

### 2.6.1 Past and Present Actions

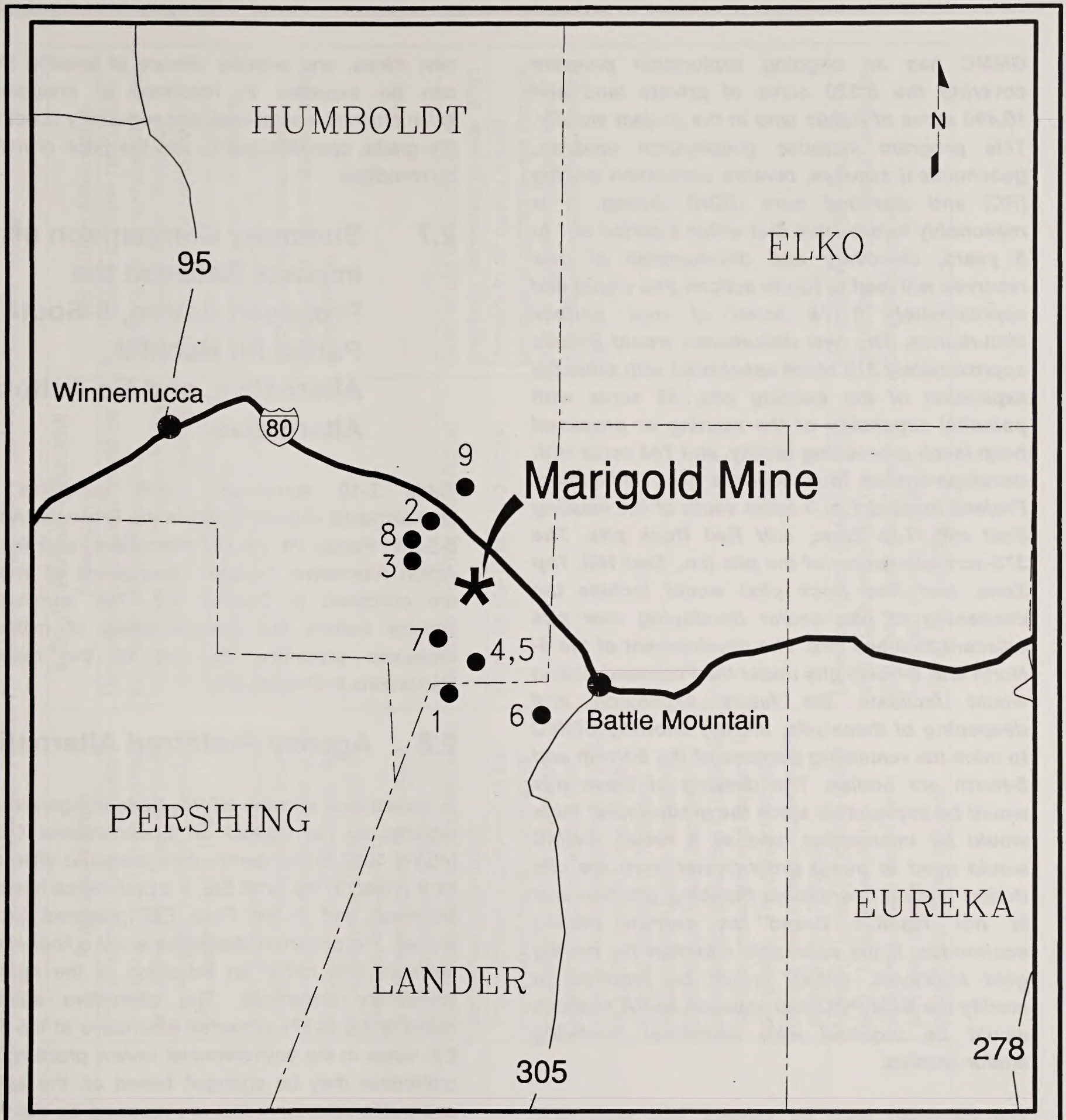
Historic activities in the area have primarily included mineral exploration and development, and livestock grazing. Mining activities have occurred throughout the area since gold was first discovered on a low ridge north of Trout Creek in 1927. Surface disturbance from historic mining operations in the area includes development of mine adits, shafts, open pits, waste rock piles, and other facilities.

There are approximately four exploration projects in the vicinity of the Marigold Mine. Exploration activities include drilling, trenching, and sampling and reclamation of the drill pads. Several mining operations also are located within the vicinity of the Marigold Mine (Map 2-7). Table 2-9 lists these mining and exploration operations, the operating company, disturbance acreage, and number of employees, when available. Four major mines (including Marigold Mine) are currently operating within 20 miles of the Marigold Mine, with an estimated total operations employment of approximately 589.

Mining activities include open pit mining, ore milling and processing, waste rock disposal, tailings disposal, and heap leaching. Recent mining activity has deepened open pits, necessitating installation of dewatering systems to prevent groundwater from entering them by lowering the groundwater table adjacent to the mine. Newmont's Lone Tree and Trenton Canyon mines are currently active (Table 2-9) and would continue to be active at the same period of time as the Proposed Action. The Valmy Power Station also is currently operating in the vicinity of the Marigold Mine.

### 2.6.2 Reasonably Foreseeable Future Actions

Mining operations within the cumulative impact assessment area that have been proposed or are in the review stage are listed in Table 2-9. Within the vicinity of the Marigold Mine, the Lone Tree Mine has proposed ***minor disturbance associated with plan modifications***, and the Phoenix Project has been proposed as an expansion of the Reona Project. Both projects are currently under review. The Phoenix Project would add approximately 210 operations personnel. Proposed dates of construction, operation, and closure are not currently known. These mines have been included in the cumulative assessment area for socioeconomic resources.




Legend

1 Buffalo Valley Mine
2 Lone Tree Mine
3 Buffalo Mountain Exploration
4 Trenton Canyon Mine
5 Trenton Canyon Exploration
6 Reona/Phoenix Project
7 Converse Exploration Project
8 Brass Ring Exploration
9 North Valmy Power Station

0 5 10 Miles
0 5 10 Kilometers

Marigold Mine

Map 2-7
Interrelated Projects

***GMMC has an ongoing exploration program covering the 8,320 acres of private land and 10,480 acres of public land in the project vicinity. This program includes geophysical analysis, geochemical surveys, reverse circulation drilling (RC) and diamond core (DDH) drilling. It is reasonably foreseeable that within a period of 1 to 5 years, discovery and development of new reserves will lead to future actions that would add approximately 1,174 acres of new surface disturbance. The new disturbance would include approximately 375 acres associated with potential expansion of the existing pits, 55 acres with potential expansion of the existing or proposed heap leach processing facility, and 744 acres with development of four deposits (i.e., Millennium Project) located 1 to 3 miles south of the existing East Hill, Top Zone, and Red Rock pits. The 375-acre expansion of the pits (i.e., East Hill, Top Zone, and Red Rock pits) would include the deepening of pits and/or developing new pits adjacent to these pits. The development of the 5-North and 8-North pits under the Proposed Action would facilitate the future expansion and deepening of these pits, thereby allowing GMMC to mine the remaining portions of the 5-North and 8-North ore bodies. The deeping of these pits would be improbable since the groundwater table would be intercepted, and as a result, GMMC would need to pump groundwater from the pits during mining operations. Pumping groundwater is not feasible based on current mining economics. If the economic situation for mining gold improves, GMMC would be required to modify the BLM POO and separate NEPA analysis would be required with additional modeling and/or studies.***

The disturbed area for present and reasonably foreseeable future mining activities in the region could be as high as approximately 18,700 acres (Table 2-9). Existing mines and exploration activities have disturbed or are permitted to disturb approximately 12,400 acres and future mining activity is projected to disturb another approximately 6,300 acres. Portions of active mines would likely be reclaimed concurrent with mining operations. Continued modification of existing mines, proposed new mines, and possibly closure of existing mines can be expected in response to changes in environmental, operational, and regulatory conditions, ore grade, operating costs, and the price of mineral commodities.

## 2.7 Summary Comparison of Impacts Between the Proposed Action, 8-South Partial Pit Backfill Alternative, and No Action Alternative

Table 2-10 summarizes and compares the environmental impacts between the Proposed Action, 8-South Partial Pit Backfill Alternative, and the No Action Alternative. Detailed descriptions of impacts are contained in Chapter 3.0. The summarized impacts include the implementation of mitigation measures presented as part of the resource discussions in Chapter 3.0.

## 2.8 Agency-Preferred Alternative

In accordance with the NEPA, Federal agencies are required by the Council on Environmental Quality (40 FR 1502.14) to identify their preferred alternative for a project in the Draft EIS, if a preference has been identified, and in the Final EIS prepared for the project. The preferred alternative is not a final agency decision; it is rather an indication of the agency's preliminary preference. The alternative identified below is the BLM's preferred alternative at the ***Final*** EIS stage in the environmental review process. This preference may be changed based on the agency and public comments that are received on this ***Final*** EIS. The BLM's preference at this time considers all information that has been received and reviewed relevant to the proposed project. The agency preferred alternative is the ***8-South Partial Pit Backfill Alternative*** as described in this EIS with all appropriate mitigation.

**Table 2-10**
**Comparisons of the Proposed Action, 8-South Partial Pit Backfill Alternative, and No Action Alternative**

| Resource Area | Proposed Action | 8-South Partial Pit Backfill Alternative | No Action Alternative |
|---|---|---|---|
| **Water Resources and Geochemistry** | The proposed mine expansion would not impact wells, springs, or surface water flows within the project area. Loss of 1.3 acres of other waters of the U.S.<br><br>5,945 linear feet of Trout Creek would be diverted (2,255 feet of this would be modifications to the old diversion). 8,050 linear feet of Cottonwood Creek would be diverted. 475 gpm of groundwater would be needed for an additional 6 years. | Groundwater impacts would be the same as the Proposed Action. Loss of 1.3 acres of other waters of the U.S. ***Eliminate the*** potential for ***the formation of a pit*** lake in ***the*** 8-South Pit. Reduced length of Trout Creek diversion. | No impacts to water resources would occur as compared to the Proposed Action. Reduced tailings seepage period. No changes in Trout Creek and Cottonwood Creek diversions. ***Potential exists for the formation of a seasonal, shallow pit lake in the existing 8-South Pit.*** |
| **Geology and Minerals** | 320,000 ounces of gold would be permanently removed. | Same as the Proposed Action | Gold would be produced as presently permitted to year 2001. |
| **Air Quality** | The proposed expansion of the mine would result in additional emissions over the short-term. Modeling results indicate that maximum concentrations of $PM_{10}$, $NO_2$, CO, and $SO_2$ would not exceed Nevada or National Ambient Air Quality Standards. MMC would follow standard construction practices to minimize fugitive emissions and impacts to air quality. The project would comply with all existing air quality standards in Nevada. | Same as the Proposed Action | Impacts to air quality would continue at current levels through 2001. Fugitive emissions would decrease through the reclamation period. |
| **Soils** | Nine soil types (mapping units) and 717 acres would be disturbed. Soils would be salvaged during ground-disturbing activities. | Nine soil types (mapping units) and 632 acres would be disturbed. Soils would be salvaged during ground-disturbing activities. | No additional soils would be impacted. Reclamation could be completed sooner. |

Table 2-10 (Continued)

| Resource Area | Proposed Action | 8-South Partial Pit Backfill Alternative | No Action Alternative |
|---|---|---|---|
| **Vegetation Resources** | Two vegetation communities totalling 717 acres would be disturbed. Areas that are not reclaimed (61 acres) would have a long-term loss of forage production. | Two communities totalling 632 acres would be disturbed. Areas that are not reclaimed (61 acres) would have a long-term loss of forage production. | No additional vegetation would be disturbed or removed. Reclamation and revegetation of existing disturbance would be completed sooner. |
| **Wildlife and Fisheries Resources** | | | |
| Wildlife habitat disturbed | 717 acres would be disturbed. | 632 acres would be disturbed. | No additional wildlife habitat would be disturbed. |
| Wildlife habitat not reclaimed | Portions of the pit areas (61 acres) would not be reclaimed. | 37 acres would not be reclaimed in the 8-South Pit. | No additional wildlife habitat would be disturbed. |
| Mule deer winter range disturbed | 717 acres would be disturbed; portions of the pit areas (61 acres) would not be reclaimed. | 632 acres would be disturbed; portions of the pit areas (61 acres) would not be reclaimed. | No additional wildlife habitat would be disturbed. |
| Animal displacement and habitat fragmentation | Increased displacement and incremental habitat fragmentation from mine development. | Same as the Proposed Action. | No additional displacement or fragmentation. |
| Impacts to breeding birds | Incremental habitat loss; indirect disturbance. | Same as the Proposed Action. | No adverse effects to breeding birds. |
| Noise and human presence. | Slight increased noise and access from mine construction. | Same as the Proposed Action. | Increased noise and human access; would continue at the current level. |
| **Special Status Species** | | | |
| Loss of potential burrowing owl ***and sage grouse*** habitat. | 674 acres of shadscale and sagebrush vegetation disturbed. | 589 acres of shadscale and sagebrush vegetation would be disturbed. | No additional habitat would be disturbed. |
| Impacts to bats. | Displacement (Red Rock Adit) of bats and incremental habitat loss. | Same as the Proposed Action | No additional displacement or incremental habitat loss would occur. |
| **Range Resources** | Temporary loss of 288 animal unit months and permanent loss of 6 animal unit months. | Same as the Proposed Action. | No permanent loss of animal unit months would occur. |

| Resource Area | Proposed Action | 8-South Partial Pit Backfill Alternative | No Action Alternative |
|---|---|---|---|
| **Land Use Authorizations and Access** | 255 acres of public lands currently used for grazing and dispersed recreation would be converted to mining activities. The land use would not result in the permanent disruption of existing rights-of-way or access to public lands in the mine vicinity. | 186 acres of public lands currently used for grazing and dispersed recreation would be converted to mining activities. No permanent disruption to existing rights-of-way or public access would occur. | There would be no change from current uses in the project area. |
| **Recreation** | 255 acres of public land would be temporarily removed from dispersed recreational use; however, adjacent public lands could be utilized. Developed recreational facilities in the region are not expected to be adversely impacted. | Same as the Proposed Action except 186 acres of public lands would be temporarily removed from dispersed recreational use. | Public lands within the project area would not be dedicated for mining and would remain available for dispersed recreational uses. |
| **Aesthetics (Visual & Noise)** | Visual contrast allowable for Visual Resource Management Class III lands within the mine site would be exceeded as a result of the new leach pads and waste rock dumps. Proposed reclamation would reduce the magnitude of most of these contrasts over time, ultimately resulting in Class III objectives being met within 10 years after the reclamation period.<br><br>Noise from mine operations would be occasionally perceptible at the nearest sensitive receptor but would be well below recognized standards. | Visual resource impacts would be the same as the Proposed Action.<br><br>Noise impacts would be the same as the Proposed Action. | Management guidelines for Visual Resource Management Class III lands would continue to be exceeded as a result of current mining operations and would be met only after the reclamation period. Project-related disturbance and construction would not occur.<br><br>Existing noise levels would decrease as current mining activities are completed and reclamation of the site is completed. |

Table 2-10 (Continued)

| Resource Area | Proposed Action | 8-South Partial Pit Backfill Alternative | No Action Alternative |
|---|---|---|---|
| **Social and Economic Values** | An average construction work force of 30 or less would be employed during the initial construction period (12 months). Up to 30 personnel (including construction work force) would be hired during the operational life of the mine, extending the employment and income benefits in the economy through ***2007***. Direct contributions to property tax, net proceeds tax, and sales taxes would increase, as would the indirect economic benefits of secondary employment, income, purchases of good and services, and resulting tax revenues. Mine closure in ***2007*** would result in a phasing out of employment, income, tax revenues, and other economic benefits. The primary communities affected would be Humboldt and Lander counties, Winnemucca, and Battle Mountain. | Same as the Proposed Action. | Mine closure in 2001 would result in the termination of the current employment of ***100*** operations personnel, and the associated direct and indirect economic benefits in local communities. Tax revenues would be phased out. Potential future economic benefits of mine operation would be foregone. |
| **Hazardous Materials** | Spills could be associated with truck deliveries of process chemicals and fuels. The number of chemical or fuel releases expected during project life is about .01. Emergency response actions would contain and cleanup any spill. Chemicals and fuels kept in storage would be contained, minimizing spill impacts. | Same as the Proposed Action. | Spill potential would be substantially reduced at the end of currently permitted mine operations. |

Table 2-10 (Continued)

| Resource Area | Proposed Action | 8-South Partial Pit Backfill Alternative | No Action Alternative |
|---|---|---|---|
| **Cultural Resources, Ethnography, and Paleontology** | Indirect effects would occur to sites Cr-NV-22-6204 and –6205 (located in the APE), due to access road work. Indirect effects to sites Cr-NV-22-6235, -6246, -6247, -6248 (located outside APE) from access road work and exploration. No sites would be directly affected.<br><br>No Tribal concerns regarding religious sites or traditional use areas have been identified. No impacts to paleontological resources are expected. | Same as the Proposed Action. | No cultural sites would be directly impacted. Erosional effects and illegal collecting would continue to occur. No impacts to paleontological resources are anticipated. |

# 3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter describes the environment that would be affected by the proposed Marigold Mine Expansion Project and the direct and indirect impacts of the Proposed Action, 8-South Partial Pit Backfill Alternative, and the No Action Alternative. The baseline information summarized in this chapter was obtained from published and unpublished materials; interviews with local, state, and Federal agencies; and from field and laboratory studies in the project area. For resources such as soils and vegetation, the affected area was determined to be the physical location and immediate vicinity of the areas to be disturbed by the proposed project. For other resources such as water resources and geochemistry, air quality, wildlife and fisheries resources, social and economic values, and the transport of hazardous materials, the affected environment was more extensive. For each of the 14 categories of resources, the affected environment was defined by the potential environmental impacts of the Proposed Action.

The analysis of impacts from the Proposed Action and 8-South Partial Pit Backfill Alternative assumed the implementation of the Environmental Protection Measures that have been developed as part of the Proposed Action and are presented in Chapter 2.0. Potential mitigation and monitoring measures developed in response to anticipated impacts are discussed at the end of each resource section. All actions listed as potential mitigation measures have been developed by the BLM and are not part of the Proposed Action. These measures could be required by the BLM as a condition or stipulation of approval of the POO. Residual adverse impacts are those remaining following the implementation of the potential mitigation measures. A discussion of cumulative impacts is included for each resource. Descriptions of short-term uses compared to long-term productivity, irreversible or irretrievable commitments of resources, and energy consumption by the proposed project are provided at the end of the chapter.

The BLM's NEPA Handbook (H-1790-1) requires that all EISs address certain Critical Elements of the Human Environment. These critical elements are presented below along with the location in this chapter where the element is discussed. If the element does not occur within the project area and would not be affected, this is indicated below, and the element is not discussed further in the EIS. This elimination of nonrelevant issues follows the CEQ guidelines as stated in 40 CFR 1500.4.

- Air Quality - refer to Section 3.3.
- Areas of Critical Environmental Concern - none would be affected.
- Cultural Heritage - refer to Section 3.14.
- Prime or Unique Farmlands - none would be affected.
- Floodplains - none would be affected.
- Native American Religious Concerns - refer to Section 3.14.
- Special Status Species - refer to Section 3.7.
- Hazardous or Solid Wastes - refer to Sections 2.2.17 and 3.13.
- Drinking Water/Groundwater Quality - refer to Section 3.1.
- Wetlands and Riparian Zones – refer to Sections 3.1 and 3.5.
- Wilderness - none would be affected.
- Paleontological Resources - refer to Section 3.14.
- Environmental Justice – refer to Section 3.14.
- Wild and Scenic Rivers – none would be affected.
- Noxious Weeds – refer to Section 3.5.

# CONSEQUENCES
# ENVIRONMENTAL
# ENVIRONMENT AND
# 3.0 AFFECTED

# 3.1 Water Resources and Geochemistry

## 3.1.1 Affected Environment

### 3.1.1.1 Waste Rock Geochemistry

Mineralization at the Marigold Mine is hosted in four principal stratigraphic units: 1) Valmy quartzite and shale; 2) the Antler/Battle Sequence consisting of conglomerates, sandstones, limestones, cherts and shales; 3) the Havallah Formation quartzites, cherts, and limestones; and 4) Edna Mountain Formation primarily consisting of limestone and calcareous siltstone. In addition, overlying alluvium is removed and stockpiled as waste rock as the existing pits are developed and expanded. The mineralized rock contains disseminated and vein siliceous gold ore along with veins of barite and occasionally jarosite. Clay alteration accompanied by iron oxides (hematite, goethite, limonite) is common in the ore zones and the waste rock (non-mineralized but altered rock) that accompanies the ore. Each of the existing and proposed pits and pit expansions has a different proportion of lithologic types and alteration types. The amount of waste rock and percentages of waste rock types removed to date from existing mine pits is summarized in Table ***B***-1 (see Appendix ***B***).

The acid-base geochemistry of waste rock is important in assessing the potential for the rock to produce acidic seepage elevated in heavy metals due to infiltration of precipitation. Similarly, the reaction of waste rock to meteoric water is important in determining if infiltration of rain water or snow melt can mobilize metals without the generation of acidic seepage. GMMC has conducted quarterly sampling and analysis of waste rock previously placed at the mine for acid-generating potential (paste pH test and static acid-base accounting) and for potential mobilization of metals by infiltrating precipitation (meteoric water mobility procedure) as required by the NDEP. The paste pH test is a quick test that estimates the potential pit of waste rock exposed to weathering. The static acid-base accounting test (static test) is used to determine if rock is potentially acid-generating. The BLM criteria for identifying non-acid-generating rocks are: 1) the net neutralizing potential (NNP) must be 20 tons/kiloton (T/kT) or greater, and 2) the ratio of the neutralizing potential (NP) to the acid-generating potential (AGP) must be 3:1 or greater. If these criteria are not met, the rock may be considered potentially acid-generating, and a kinetic humidity cell test would be required to measure in the laboratory the level of acidity and metals that would be generated by the rock when exposed to water and air. These geochemical tests are summarized below.

**Testing Methods**

**1) Paste pH Test**. This is a simple field test to quickly estimate the potential pH that could be generated as a result of weathering of rock. The rock is crushed, finely ground, and mixed with deionized water to form a paste. The pH of the paste is measured. This test is a very rough guide to the potential pH of an effluent that could be generated by weathering of rock.

**2) Static Acid-Base Accounting (Static ABA Test)**. In the static ABA test, the AGP of the rock is estimated from the amount of reactive sulfur in the rock. Pyrite is the most reactive sulfide found in both metal mines and coal mines, but other sulfides can generate acidic effluent in the presence of pyrite. Commonly, however, the acid-generating potential of a rock is based on the pyrite content and expressed as T/kT of equivalent calcium carbonate. The NP of a rock is based on the ability of the rock to neutralize acid in the laboratory. The principal acid-neutralizing minerals in mineralized and altered rocks associated with gold deposits are carbonate minerals, clays, and feldspars. The NP of the rock also is expressed as T/kT of calcium carbonate equivalent. The NNP of the rock is simply: NNP = NP – AGP. This value should be equal to or greater than 20 T/kT for the rock to be classified as non-acid-generating under the BLM's Acid Rock Drainage Policy (BLM 1996). Similarly, the NP/AGP should be 3:1 or greater for a rock to be classified as non-acid-generating. These criteria are sometimes waved by the BLM for rocks with low pyrite content (pyrite less than 0.5 percent). If these

criteria are not met, the rock can be classified as potentially acid-generating, and a kinetic humidity cell test would be required to determine the acidity of the effluent generated when the rock is exposed to water and air.

3) **Nevada Meteoric Water Mobility Procedure (MWMP)**. The MWMP test is a conservative test to estimate the level of metals that can be mobilized from crushed waste rock using simulated rainwater. The crushed rock is equilibrated with water in a closed container for a period of 24 hours. This simulates the effects from contact with rainwater. The resultant water is then analyzed for constituents of concern, usually the constituents specified in the state water quality standards. For Nevada, this list of constituents is contained in the Nevada Profile II elements. If one or more constituents exceed the water quality standards, then the placement of the waste rock and the reclamation of the waste rock dump are evaluated with emphasis on minimizing the infiltration of precipitation and reducing possible impacts to surface and groundwater if seepage should occur from the waste rock dump.

4) ***Column Leach Test Procedure. Leaching of waste rock material by groundwater or meteoric water (rain water) can be simulated in the laboratory by placing crushed rock in a column and allowing water to percolate through the column for a designated period of time. The rock is usually crushed to a specified size to simulate the waste rock as it would be placed in a waste rock pile. A charge is selected by splitting crushed waste rock for the column and packing this material into the column. The columns can be of any length or diameter, but commonly the columns are 6 to 10 feet in length with an inside diameter of 6 to 12 inches. The columns are then filled with meteoric water or groundwater (whichever is being evaluated for leaching) and allowed to stand for 24 hours to saturate the waste rock. A sample is then drawn from the column through a spigot and saved for analysis. Water is added to the column to replace the water lost in sampling and to maintain a constant head on the column. Samples are then drawn at designated intervals, which can be at intervals of days or weeks, depending of the design of the test.***

***In the case of the column leach tests run on waste rock from the Marigold Mine, groundwater from the mine site was used to leach the waste rock and samples were drawn weekly for 20 weeks. The columns were 10 feet high and filled to a height of about 4 feet. The inside diameter of the columns was 12 inches. This test simulated the leaching of waste rock that would be used to backfill a pit that may have a pit lake. The groundwater was continually cycled through the waste rock for the duration of the leach tests. Each sample taken was analyzed for pH, electrical conductivity, and TDS (total dissolved solids) immediately and then a separate sample of the leachate was sent for analysis of Nevada Profile I metals. The weekly sample analyses showed a progressive change in water quality of the leachate due to the progressive removal of the metals and sulfate from the surfaces of the waste rock. During the column leach tests, the water quality of the leachate eventually stabilized, indicating the probable long-term water quality of the leachate under natural conditions of leaching of the waste rock by groundwater flowing through a backfilled pit.***

## Data Collection

GMMC has been collecting waste rock samples on a quarterly basis for testing since 1992. The static ABA test and the MWMP test have been routinely run on waste rock from each pit being mined, as required by the NDEP. Tables ***B***-2 and ***B***-3 (see Appendix ***B***) present a summary of the static ABA, paste pH, and MWMP data from GMMC's ongoing evaluation of waste rock. Static ABA tests ***have been*** conducted on waste rock from the proposed 8-North and 5-North pit areas ***(Appendix B, Tables B-4 and B-5)***.

**Static ABA Test Results**

The results of previous static ABA tests at the Marigold Mine (***Appendix B***, Table ***B***-2) can be grouped by rock type and by the pit from which the waste rock was generated. Evaluation of the data focused on pyrite content since rocks containing pyrite are the main reactive components in Marigold Mine ore and waste rock. These rock types and areas are described below. Only formations that require additional discussion regarding their acid-generating potential are identified below. See ***Appendix B,*** Tables ***B***-2 and ***B***-3 for a complete geochemical analysis of all formations.

**Tailings Solids**: These solids have pyrite generally below 1 percent, a pyritic NNP greater than 20 T/kT, and an NP/AGP of 3:1 or greater. They are thus classified as non-acid-generating based on pyritic sulfur. If total sulfur is used, some samples would fail one or both criteria for non-acid-generating because of the large percentage of unidentified sulfur. However, the low pyrite content (less than 1 percent) and the paste pH values of greater than 7.0 suggest than the existing tailings solids are non-acid-generating.

**Leach Solids**: These solids are the spent ore found in the existing leach pads. The pyrite content is generally less than 1 percent. The pyritic NNP and the NP/AGP ratio are variable due to the low neutralizing potential of these solids. Also, the total sulfur NNP and NP/AGP ratio are variable due to both the low neutralizing potential and the high percentage of unidentified sulfur. However, the low pyrite content and the paste pH values, that are generally greater than 7.0, suggest that these solids are not acid-generating.

**8-South Waste Rock**: This waste rock is a variable mixture of alluvium, Valmy Formation quartzites and shales, and the Antler/Battle Sequence carbonate-rich rocks. As shown in Table ***B***-1 (Appendix ***B***), alluvium was initially greater than 50 percent of the waste rock but declined to less than 20 percent by 1992. The Valmy Formation and the Antler/Battle Sequence have dominated the waste rock since 1992. The static ABA test results show that pyrite is generally less than 0.5 percent and total sulfur is less than 1.0 percent in the waste rock. The NNP is variable, but generally above 20 T/kT. The NP/AGP also is quite variable and can be below the guideline of 3:1. The paste pH is greater than 7.0. The paste pH coupled with the low pyrite content and an NNP generally around or greater than 20 T/kT suggests that waste rock from the 8-South Pit is not acid-generating.

**Top Zone Waste Rock**: Top Zone waste rock is mostly Valmy Formation quartzites and shales with minor additions from the Antler/Battle Sequence, as indicated in Table ***B***-1 (Appendix ***B***). The pyrite content is less than 0.5 percent and the total sulfur content also is less than 0.5 percent. The NNP is highly variable due to the low neutralizing capacity (NP) of the Valmy rocks and can be below 20 T/kT for both pyritic sulfur NNP and total sulfur NNP. Similarly, the NP/AGP is variable but generally greater than 3:1. The paste pH is above 8.0. The low pyrite content coupled with the paste pH above 7.0 suggests that Top Zone waste rock, which is mostly Valmy Formation with some Antler/Battle Sequence rocks, is not acid-generating.

**East Hill North Waste Rock**: East Hill waste rock is a mixture of Valmy, Antler/Battle, and Havallah rocks, with Valmy and Antler/Battle Sequence rocks being predominant. Total sulfur is less than 0.5 percent and pyrite is less than 0.1 percent. The NNP is highly variable for both the pyritic component and the total sulfur values. Because both pyrite and total sulfur are low, the variations in the neutralizing capacity of the waste rock (NP) controls the NNP and the NP/AGP ratio. Paste pH values are greater than 8.0. Thus, Valmy Formation quartzites and shales, the Antler/Battle conglomerates and limestones, and the carbonate rocks of the Havallah Formation from the East Hill North Pit are not considered to be acid-generating.

**East Hill South Waste Rock**: To date, all the waste rock from this pit is from the Valmy Formation with

pyrite less than 0.1 percent and an NNP greater than 20 T/kT. This waste rock is not acid-generating according to NDEP and BLM guidelines.

**Red Rock North Waste Rock**: Red Rock North waste rock is composed mainly of Antler/Battle Sequence rocks with some Valmy Formation. Pyrite is again less than 0.1 percent and total sulfur is less than 0.5 percent. The NNP is variable and controlled by the acid-neutralizing capacity of the waste rock (NP) because of the low pyrite and total sulfur contents. The paste pH values are above 7.0. Waste rock from this pit is not considered to be acid-generating.

***8-North Waste Rock. Waste rock from the proposed 8-North Pit would be composed mainly of the Edna Mountain Formation and Havallah Formation lithologic units. Drill core samples from the Havallah Formation in the area of the proposed 8-North Pit contained up to 0.28 percent pyritic sulfur, with pyritic sulfur values ranging from 0.01 percent to 0.28 percent. The NNP of the Havallah Formation rocks ranged from –4.6 T/kT to 64.8 T/kT. The ratio of ANP/AGP ranged from 0.5 to 99.5 with 1.43 percent of the samples having an ANP/AGP ratio less than 3:1. As shown in Tables B-4 and B-5 (Appendix B), 50 percent of the Havallah Formation samples had an NNP less than 20 T/kT. The paste pH of these samples was generally greater than 7.5. Thus, not all the Havallah Formation rocks meet the BLM guidelines for non-acid generating. However, the paste pH values of 7.5 or greater and the low pyritic sulfur values suggest that most Havallah Formation rocks in the 8-North Pit area would be non-acid generating.***

***Drill core samples of the Edna Mountain Formation rocks from the area of the proposed 8-North Pit contained pyritic sulfur up to 0.13 percent, with the values ranging from 0.01 percent to 0.13 percent. The NNP of these samples ranged from 10 T/kT to 115 T/kT (Table B-4, Appendix B). Approximately 50 percent of the Edna Mountain Formation samples had an NNP less than 20 T/kT. The ANP/AGP ratio for these Edna Mountain Formation samples ranged from 3.5 to 42.7. The paste pH values were generally greater than 7.5. Therefore, not all of the Edna Mountain Formation samples in the 8-North Pit area meet the BLM guidelines for non-acid generating. However, the high paste pH values and the consistent ANP/AGP ratio above 3:1 along with the low pyritic sulfur values suggest that most of the Edna Mountain rocks would be non-acid generating.***

***5-North Waste Rock. Waste rock from the proposed 5-North Pit would include the Antler Peak, Battle Formation, Edna Mountain, and Havallah Formation lithologies. Havallah Formation samples had pyritic sulfur values ranging from less than 0.01 percent to a maximum of 0.06 percent. The NNP for these samples ranged from 3.2 to 104 T/kT, with the ANP/AGP ratio ranging from 3.5 to 110. The paste pH for the Havallah Formation rocks was 8.0 or greater. However, 50 percent of the samples had an NNP value of less than 20 T/kT. Thus, not all of the Havallah Formation rocks meet the BLM criteria for non-acid generating. However, the low pyritic sulfur values along the high paste pH values and the ANP/AGP ratios above 3:1 suggest that most Havallah Formation rocks in the 5-North Pit area would be non-acid generating.***

***Edna Mountain Formation rocks from the 5-North Pit area had pyritic sulfur ranging from less than 0.01 percent to a maximum of 0.87 percent. The NNP for these samples ranged from 107 to 613 T/kT and the paste pH values were 8.0 or greater. Thus, the Edna Mountain rocks from the 5-North Pit area can be considered non-acid generating using BLM guidelines.***

***Antler Peak Formation rocks from the 5-North Pit area had pyritic sulfur values ranging from less than 0.01 percent to 0.59 percent. The NNP values ranged from 388 to 730 T/kT and the paste pH***

***values were 8.0 or greater, making these samples non-acid generating using BLM guidelines.***

***Battle Formation rocks from the 5-North Pit area had pyritic sulfur values below 0.01 percent. The NNP values ranged from 76 to 787 T/kT with paste pH values at 8.0 or greater. All of these samples would be considered non-acid generating using BLM guidelines.***

***The Valmy Formation rocks from the 5-North Pit area had pyritic sulfur values ranging from less than 0.01 percent to 0.02 percent. The NNP values, however, were all less than 20 T/kT (Table B-4, Appendix B). The paste pH values for these samples were 8.0 or greater and the ANP/AGP ratios for the samples ranged from 2.3 to 28.0, with 16.7 percent of the samples having an ANP/AGP ratio of less than 3:1. Thus, the Valmy Formation rocks in the 5-North Pit area do not meet the BLM criteria for non-acid generating. However, the low pyritic sulfur values and the high paste pH values suggest the rocks would not likely generate acidic seepage due to the low pyrite content.***

**Nevada Meteoric Water Mobility Procedure Test (MWMP) Results**

The results of MWMP tests on existing Marigold Mine waste rock are provided in Table ***B***-3 (Appendix ***B***) and are summarized below. The effluent from these laboratory tests was analyzed for Nevada Profile II constituents, as required by the NDEP. Nevada water quality standards for the Profile II constituents are presented in Table 3-1.

**Tailings Solids**: Tailings solids show consistent exceedence of drinking water and aquatic life standards for WAD cyanide. Similarly, arsenic and mercury show consistent exceedence of all water quality standards. Molybdenum shows exceedence of the aquatic life standard. Other metals may show an exceedence in a few samples, but generally are within Nevada water quality standards.

**Leach Solids**: Leach solids show frequent exceedence of drinking water standards for arsenic and mercury. Occasionally, the aquatic life water quality standard is exceeded. Other metals are within Nevada water quality standards.

**8-South Waste Rock**: Waste rock from the 8-South Pit shows exceedence of the Nevada drinking water standard for arsenic; however the stock water standard for arsenic is generally not exceeded. Similarly, mercury shows exceedence of drinking water and aquatic life standards, but stock water standards are generally not exceeded. Other metals are within Nevada state water quality standards. Waste rock from this pit is a mixture of alluvium, Valmy Formation, and the Antler/Battle Sequence rocks.

**Top Zone Waste Rock**: The Top Zone Pit waste consistently exceeds all water quality standards for arsenic. Both Valmy rocks and the Antler/Battle Sequence rocks from this pit have elevated arsenic values. Fluoride occasionally exceeds the stock water standard and mercury occasionally exceeds the drinking water standard for waste rock from this pit. Other metals are within Nevada state water quality standards. Top Zone waste rock is mostly Valmy Formation quartzites and shales.

**East Hill Waste Rock**: Waste rock from the East Hill Pit (North and South) commonly exceeds Nevada drinking water standards for total dissolved solids (TDS), chloride, and sulfate. Arsenic levels consistently exceed drinking water standards and often exceed all other standards. Molybdenum levels exceed the State aquatic life water quality standards. Other metals are within Nevada state water quality standards. East Hill waste rock is a composite of Valmy, Antler/Battle Sequence rocks, and Havallah Formation rocks.

**Red Rock North Waste Rock**: Waste rock from the Red Rock North Pit meets drinking water standards and all other water quality standards for all metals except arsenic. Red Rock waste rock is composed mainly of Antler/Battle Sequence with some Valmy rocks.

**Table 3-1**
**Nevada Water Quality Standards**

| Parameter[2] | Drinking Water Standards[1] | | | Nevada Agriculture | | Aquatic Life | |
|---|---|---|---|---|---|---|---|
| | EPA Primary | EPA Secondary | Nevada | Irrigation | Stock Water | 1-hour Average | 96-hour Average |
| Aluminum | | .05 to 0.2 | | | | | |
| Antimony | 0.006 | | | | | | |
| Arsenic | 0.05 | | 0.05 | | 0.2 | ***0.342**** As (III) | ***0.180**** As (III) |
| Barium | 2 | 2 | 2 | 0.1 | | | |
| Beryllium | 0.004 | | | | | | |
| Boron | | | | 0.1 | 5 | | |
| Cadmium | 0.005 | | 0.005 | 0.75 | 0.05 | "3"[6]* | "3"* |
| Chloride | | 250 | 250(400)[3] | 0.01 | 1500 | | |
| Chromium | 0.1 | | 0.1 | | 1 | ***0.015**** Cr (VI) ***"3" Cr (III)**** | ***0.010**** Cr (VI) ***"3" Cr (III)**** |
| Copper | [4] | 1 | | 0.1 | 0.5 | "3"* | "3"* |
| Cyanide (WAD)[5] | 0.2 | | 0.2 | 0.2 | | 0.022 | 0.0052 |
| Fluoride | 4 | 2 | | | 2 | | |
| Iron | | 0.3 | | 1 | | 1.0 | 1.0 |
| Lead | [4] | | 0.05 | 5 | | "3"* | "3"* |
| Magnesium | | 150 | | | | | |
| Manganese | | 0.05 | | | | | |
| Mercury | 0.002 | | 0.002 | 0.2 | 0.01 | 0.002* | 0.000012 |
| ***Molybdenum*** | | | | | | ***0.019*** | ***0.019*** |
| Nickel | 0.1 | | 0.0134 | | | "3"* | "3"* |
| Nitrate (as N) | 10 | | 10 | 0.2 | 100 | ***≤10*** | ***≤10*** |
| pH | | 6.5-8.5 | 5.0-9.0 | | 5.0-9.0 | 6.5 – 9.0 | 6.5 – 9.0 |
| Selenium | 0.05 | | 0.05 | 4.5-9.0 | 0.05 | 0.02 | 0.005 |
| Silver | | | | | | "3" | "3" |
| Sulfate | | 250 | 250(500)[3] | 0.02 | | | |
| ***Sulfide*** | | | | | | ***0.002*** | ***0.002*** |
| TDS | | 500 | 500(1,000)[3] | | 3000 | | |
| Thallium | 0.002 | | 0.013 | | | | |
| Zinc | | 5 | | | 25 | "3" | "3" |

[1]More stringent of EPA and Nevada Drinking Water Standards for each parameter is applicable in Nevada.
[2]Units are mg/l unless noted. SU = standard units; TDS = Total dissolved solids.
[3]Indicates numbers in ( ) are mandatory secondary standards for public water supply.
[4]Action level for copper is 1.3 mg/l; action level for lead is 0.015 mg/l.
[5]WAD = Weak Acid Dissociable.
[6]"3"= Numbers dependent on hardness; see NAC 445.1339 for equations.

*= Numbers apply to dissolved fraction.

Source: Nevada (1995) LCB File No. R128-95, Amendment to NAC 445.144; U.S. EPA Drinking Water Regulations and Health Advisories, February 1996.

**8-North Waste Rock**. Samples of potential waste rock from the proposed 8-North Pit include the Antler Peak and Havallah Formation lithologic units. Both units showed an exceedence of the Nevada stock water standard for fluoride, and there is a potential that State drinking water standards for mercury and selenium could be exceeded.

**5-North Waste Rock**. Samples of potential waste rock from the proposed 5-North Pit include Antler Peak, Battle Formation, Edna Mountain, and Havallah Formation lithologic types. The Battle Formation, Edna Mountain, and Havallah rocks showed exceedences of the Nevada drinking water standard for mercury (***Appendix B, Table B-3***). The Antler Peak sample showed an exceedence of the State drinking water standard for selenium.

The results of the MWMP tests show a consistent pattern for waste rock at the Marigold Mine. Effluent from existing waste rock is elevated above State drinking water standards for arsenic, mercury, and often molybdenum and is frequently elevated above State aquatic life and stock water standards for arsenic. The East Hill pits have waste rock that produces an effluent that exceeds State drinking water standards for TDS, chloride, sulfate, and arsenic. This suggests that if water should contact waste rock at the Marigold Mine, either through infiltration of precipitation into a waste rock dump or through infiltration of a backfilled pit with a pit lake, then the resulting effluent water could be elevated in arsenic and mercury above most Nevada water quality standards. Molybdenum, TDS, chloride, and sulfate may be elevated, depending on the origin of the waste rock.

***Column Leach Test Results***

***Column leach tests were conducted for rock samples collected from the Havallah and Edna Mountain Formations, which would constitute waste rock from the 8-North, 8-South, and 5-North pits (Appendix B, Table B-7). Neither sample generated acidic effluent after the 20-week required testing period. The Edna Mountain sample had a pH ranging between 7.6 and 8.3 standard units during the testing period. Results from the tests indicated that metal levels did not exceed Nevada drinking water standards and TDS and sulfate levels were below 250 mg/l and 100 mg/l, respectively. The Havallah Formation sample had a pH ranging between 7.7 and 8.4 during the testing period. Results from the tests indicated that the maximum aluminum level was 0.268 mg/l at week 7, which is higher than the Nevada drinking water standard of 0.05 mg/l. No other metal levels exceeded the Nevada drinking water standards. The TDS and sulfate levels were below 500 mg/l and 100 mg/l, respectively.***

### 3.1.1.2 Surface Water Resources

**Surface Water Quantity**

Average annual precipitation in the area ranges from 6 to 8 inches along the valley floors and foothills, with greater amounts (up to 15 inches) occurring at higher elevations on Battle Mountain (Nevada Department of Conservation and Natural Resources 1964). Mean annual precipitation at the town of Battle Mountain is approximately 7.8 inches (National Climatic Data Center 1999). Most of the precipitation occurs as winter snow. The average annual evaporation from lake surfaces in the locale is approximately 45 inches, with approximately 35 inches evaporating between May and October (National Oceanic and Atmospheric Administration [NOAA] 1982). Annually, the evapotranspiration rate in the area approximates the precipitation rate (Eakin and Lamke 1966).

The project area lies within the ***Clovers Area*** (Nevada Hydrographic Basin ***64***), which ***includes a reach of the Humboldt River and tributaries***. Tributary streams drain generally northward from canyons on Battle Mountain onto relatively flat alluvial fans. Flows disperse and infiltrate into the fans; the remaining channel system eventually drains to the Herrin Slough, which is located approximately 5 miles northeast of the project facilities. Herrin Slough is a

channel feature that drains northwestward across the floodplain deposits of the Humboldt River. After paralleling the river for several miles, the slough meets the river at a confluence approximately 7 miles north of the existing project facilities.

Flows in the Humboldt River vary widely from year to year as a result of changes in precipitation, agriculture water use, transpiration by native vegetation, and flow gains or losses from aquifers. The average annual flow in the river at Battle Mountain is approximately 400 cubic feet per second (cfs). The high flow months are typically May or June, which have long-term average flows of approximately 1,000 cfs. The highest recorded average flow for June is approximately 5,800 cfs, which occurred in 1952. Low flow months extend from September through February, with September typically having the lowest average flow rates. The long-term average September flow at Battle Mountain is approximately 25 cfs. The river often goes dry for several days or weeks during the low flow months (U.S. Geological Survey [USGS] 1999). Losses in flow typically occur downstream of Palisade (approximately 15 miles downstream of Carlin) as a result of agricultural withdrawals, evapotranspiration, and groundwater recharge. With regard to water rights, the river system is over-appropriated, with more demand from the stream water than there is supply.

Two named and two unnamed drainages are located within the Marigold Mine project area (see Map 3-1). The westernmost drainage is Cottonwood Creek, which has a watershed area of approximately 14 square miles. The Cottonwood Creek channel trends generally northward from higher elevations on Battle Mountain and passes through the western part of the project area. Upon leaving the foothills and reaching the major alluvial fan system, it turns northeastward past the existing mining facilities toward the river. No data measurements are available regarding the duration or magnitude of flows in Cottonwood Creek or their chemical characteristics within the project area. Other measurements (JBR 1996a) indicate that Cottonwood Creek is intermittent to perennial (October flows on the order of 0.07 cfs) 2 to 3 miles south of the project area. Based on observed conditions, flows in Cottonwood Creek are intermittent and flow seasonally in response to snowmelt or as a result of infrequent precipitation events, similar in a general fashion to those in Trout Creek described below.

Trout Creek generally parallels Cottonwood Creek approximately one-half to one-eighth of a mile to the east. Trout Creek is perennial in its upper reaches on Battle Mountain upstream of the project area boundary. Downgradient reaches are intermittent, because of seepage from the channel into the deeper alluvium (JBR 1998). Trout Creek flows through the existing mine facilities and is diverted through the operations along approximately 1,700 feet of its length. The existing diversion system is approved under earlier agency permits.

Flow monitoring and water quality sampling has been conducted for the segment of Trout Creek that passes through the project area. Flow in the creek during the 1998 season was unusually high and of long duration due to a heavy winter snowpack and lengthy subsequent snowmelt. Regional data confirm that the snow water equivalent in the area was approximately three times the long-term average (Natural Resources Conservation Service 1999). As a result, average flows in Trout Creek are likely to be significantly less than were measured in the spring and summer of 1998. Flow in the creek in 1998 lasted from March 23 through July 6 of that year. The average discharge during that period was 29.7 cfs, with a peak flow rate of 55.5 cfs. Flow velocities ranged from approximately 3 to 6 feet per second (Hepworth 1999).

The unnamed eastern drainage (lying immediately to the east of Trout Creek) (Map 3-1) is an ephemeral system. The watershed area occupies approximately 4 square miles, but much of this area has been disturbed by mining and includes pit areas that no longer contribute to surface runoff. The drainage path has been diverted to the east past the tailings facility in Section 9, T33N, R43E. No stream discharge or water quantity data are available for this drainage (JBR 1998).

Legend

- Watershed Divide
- Stream
- Surface Water Study Area
- Spring
- Mine Sites

80

Lone Tree Mine

Herrin Slough

Humboldt Ri

T34N

T3

Rocky

Willow

Copper Canyon

Canyon

Phoenix Project

R42E

R43E

R44E

0 1 2 3 4 Mile

Marigold Mine

Map 3-1

Project Area Watersheds

channel feature that drains northwestward across the floodplain deposits of the Humboldt River. After paralleling the river for several miles, the slough meets the river at a confluence approximately 7 miles north of the existing project facilities.

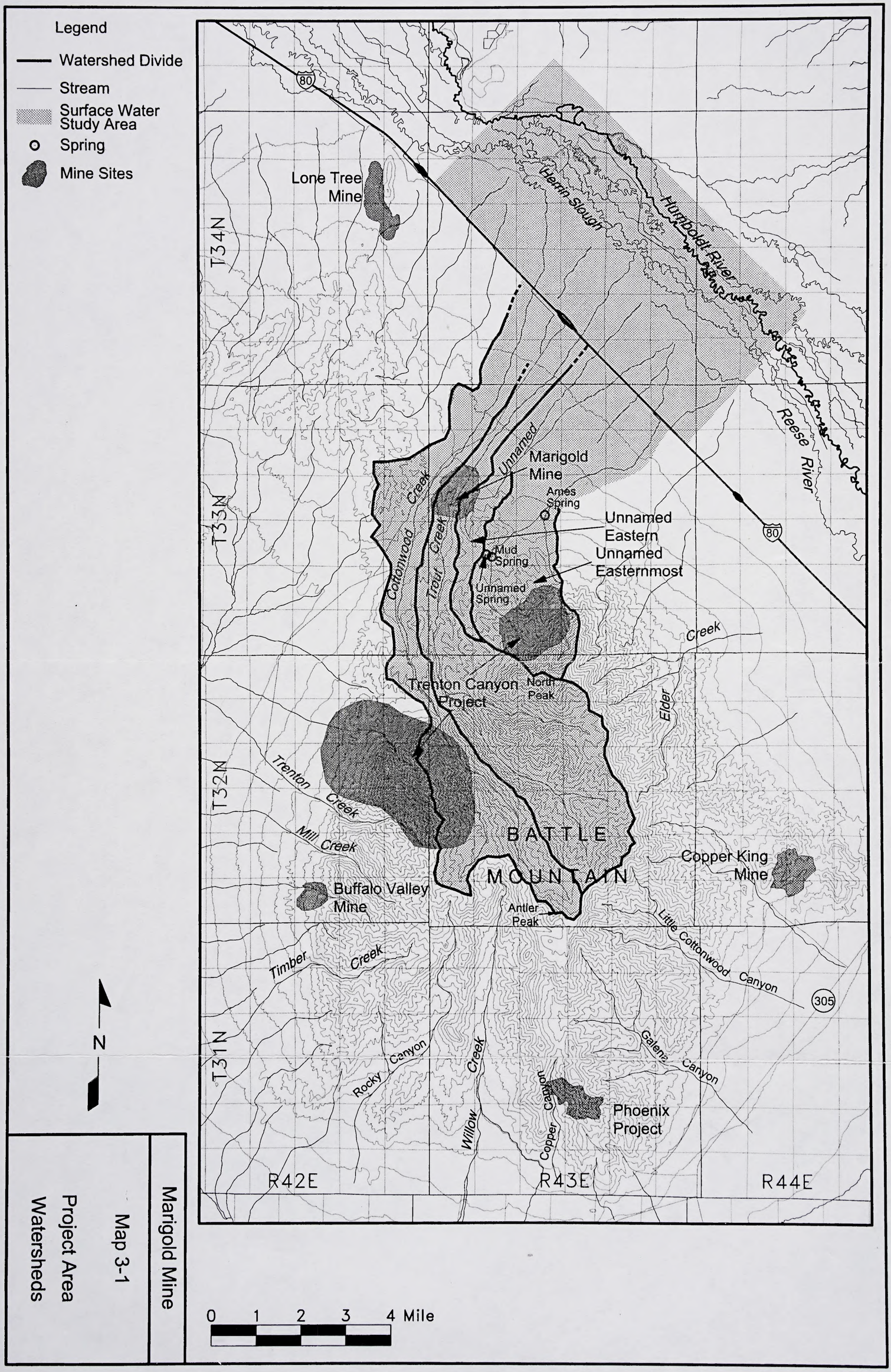
Flows in the Humboldt River vary widely from year to year as a result of changes in precipitation, agriculture water use, transpiration by native vegetation, and flow gains or losses from aquifers. The average annual flow in the river at Battle Mountain is approximately 400 cubic feet per second (cfs). The high flow months are typically May or June, which have long-term average flows of approximately 1,000 cfs. The highest recorded average flow for June is approximately 5,800 cfs, which occurred in 1952. Low flow months extend from September through February, with September typically having the lowest average flow rates. The long-term average September flow at Battle Mountain is approximately 25 cfs. The river often goes dry for several days or weeks during the low flow months (U.S. Geological Survey [USGS] 1999). Losses in flow typically occur downstream of Palisade (approximately 15 miles downstream of Carlin) as a result of agricultural withdrawals, evapotranspiration, and groundwater recharge. With regard to water rights, the river system is over-appropriated, with more demand from the stream water than there is supply.

Two named and two unnamed drainages are located within the Marigold Mine project area (see Map 3-1). The westernmost drainage is Cottonwood Creek, which has a watershed area of approximately 14 square miles. The Cottonwood Creek channel trends generally northward from higher elevations on Battle Mountain and passes through the western part of the project area. Upon leaving the foothills and reaching the major alluvial fan system, it turns northeastward past the existing mining facilities toward the river. No data measurements are available regarding the duration or magnitude of flows in Cottonwood Creek or their chemical characteristics within the project area. Other measurements (JBR 1996a) indicate that Cottonwood Creek is intermittent to perennial (October flows on the order of 0.07 cfs) 2 to 3 miles south of the project area. Based on observed conditions, flows in Cottonwood Creek are intermittent and flow seasonally in response to snowmelt or as a result of infrequent precipitation events, similar in a general fashion to those in Trout Creek described below.

Trout Creek generally parallels Cottonwood Creek approximately one-half to one-eighth of a mile to the east. Trout Creek is perennial in its upper reaches on Battle Mountain upstream of the project area boundary. Downgradient reaches are intermittent, because of seepage from the channel into the deeper alluvium (JBR 1998). Trout Creek flows through the existing mine facilities and is diverted through the operations along approximately 1,700 feet of its length. The existing diversion system is approved under earlier agency permits.

Flow monitoring and water quality sampling has been conducted for the segment of Trout Creek that passes through the project area. Flow in the creek during the 1998 season was unusually high and of long duration due to a heavy winter snowpack and lengthy subsequent snowmelt. Regional data confirm that the snow water equivalent in the area was approximately three times the long-term average (Natural Resources Conservation Service 1999). As a result, average flows in Trout Creek are likely to be significantly less than were measured in the spring and summer of 1998. Flow in the creek in 1998 lasted from March 23 through July 6 of that year. The average discharge during that period was 29.7 cfs, with a peak flow rate of 55.5 cfs. Flow velocities ranged from approximately 3 to 6 feet per second (Hepworth 1999).

The unnamed eastern drainage (lying immediately to the east of Trout Creek) (Map 3-1) is an ephemeral system. The watershed area occupies approximately 4 square miles, but much of this area has been disturbed by mining and includes pit areas that no longer contribute to surface runoff. The drainage path has been diverted to the east past the tailings facility in Section 9, T33N, R43E. No stream discharge or water quantity data are available for this drainage (JBR 1998).


Legend
Watershed Divide
Stream
Surface Water Study Area
Spring
Mine Sites
Lone Tree Mine
Herrin Slough
Humboldt River
Reese River
Unnamed Creek
Marigold Mine
Ames Spring
Unnamed Eastern
Unnamed Easternmost
Mud Spring
Unnamed Spring
Cottonwood Creek
Trout Creek
Trenton Canyon Project
North Peak
Elder Creek
Trenton Creek
Mill Creek
BATTLE MOUNTAIN
Copper King Mine
Buffalo Valley Mine
Antler Peak
Little Cottonwood Canyon
Timber Creek
Rocky Canyon
Willow Creek
Galena Canyon
Copper Canyon
Phoenix Project
T34N
T33N
T32N
T31N
R42E
R43E
R44E
80
305
N
0 1 2 3 4 Mile
Marigold Mine
Map 3-1
Project Area Watersheds

## Table 3-2
## Trout Creek Water Quality [1]

| Analysis (mg/L unless otherwise specified) | March 1998 Upstream[2] | March 1998 Downstream[3] | May 1998 Upstream | May 1998 Downstream | July 1998 Upstream | July 1998 Downstream |
|---|---|---|---|---|---|---|
| pH | 8.06 | 8.06 | 8.01 | 8.10 | 8.48 | 8.24 |
| TDS | 161 | 160 | 155 | 155 | 186 | 196 |
| Alkalinity as $CaCO_3$ | 98.6 | 98.8 | 82.8 | 83.2 | 135 | 144 |
| Bicarbonate | 98.6 | 98.8 | 82.8 | 83.2 | 129 | 144 |
| Carbonate | <1.0 | <1.0 | <1.0 | <1.0 | 6.7 | <1.0 |
| Hydroxide | | | | | | |
| Total Cl | 13.6 | 13.9 | 10.2 | 9.8 | 18.0 | 20.2 |
| Total F | 0.4 | 0.3 | 0.2 | 0.2 | 0.4 | 0.4 |
| $NO_2$+$NO_3$-N | 0.15 | 0.16 | 0.10 | 0.09 | <0.02 | <0.02 |
| Total Sulfate | 31.3 | 31.2 | 19.8 | 19.8 | 34.7 | 37.7 |
| Total As | 0.005 | 0.008 | 0.004 | 0.011 | 0.005 | 0.005 |
| Dissolved As | 0.003 | 0.003 | 0.002 | 0.002 | 0.006 | 0.006 |
| Total Ba | 0.086 | 0.116 | 0.081 | 0.124 | 0.066 | 0.151 |
| Dissolved Ba | 0.041 | 0.045 | 0.044 | 0.045 | 0.071 | 0.113 |
| Total Cd | <0.002 | <0.002 | ***0.005*** | 0.003 | <0.002 | <0.002 |
| Dissolved Cd | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| Total Ca | 25.9 | 28.7 | 19.3 | 20.1 | 31.7 | 33.2 |
| Dissolved Ca | 27.9 | 26.7 | 20.9 | 20.5 | 35.5 | 36.4 |
| Total Cr | <0.008 | <0.008 | <0.008 | <0.008 | <0.008 | <0.008 |
| Dissolved Cr | <0.008 | <0.008 | <0.008 | <0.008 | <0.008 | <0.008 |
| Total Cu | 0.004 | 0.013 | 0.012 | 0.013 | <0.004 | <0.004 |
| Dissolved Cu | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 |
| Total Fe | ***2.49*** | ***4.32*** | ***1.95*** | ***2.92*** | 0.048 | ***0.763*** |
| Dissolved Fe | 0.066 | 0.078 | <0.019 | 0.024 | <0.019 | <0.019 |
| Total Pb | 0.008 | 0.006 | 0.004 | 0.004 | 0.003 | 0.003 |
| Dissolved Pb | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Total Mg | 9.34 | 10.0 | 6.31 | 6.65 | 10.8 | 11.4 |
| Dissolved Mg | 9.72 | 9.28 | 6.55 | 6.38 | 12.3 | 12.5 |
| Total Mn | ***0.093*** | ***0.132*** | ***0.071*** | ***0.089*** | <0.001 | 0.019 |
| Dissolved Mn | 0.004 | 0.004 | 0.002 | 0.003 | 0.002 | 0.004 |
| Total Hg | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 |
| Dissolved Hg | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 |
| Total K | 1.8 | 2.9 | 2.5 | 2.8 | 2.0 | 3.4 |
| Dissolved K | 1.6 | 2.2 | <1.5 | 2.5 | 2.0 | 3.7 |
| Total Se | <0.002 | <0.002 | <0.002 | 0.002 | <0.002 | 0.002 |
| Dissolved Se | <0.002 | <0.002 | 0.002 | <0.002 | <0.002 | 0.003 |
| Total ag | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| Dissolved ag | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| Total Na | 21.1 | 20.5 | 18.5 | 18.7 | 26.6 | 29.2 |
| Dissolved Na | 22.7 | 21.7 | 20.6 | 19.9 | 29.4 | 33.0 |
| Total Zn | 0.033 | 0.039 | 0.034 | 0.037 | <0.004 | 0.006 |
| Dissolved Zn | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 |
| Total WAD Cyanide | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |

[1]Results shown in bold italics meet or exceed water quality standards shown in Table 3-1.
[2]Upstream = opposite Red Rock Pit.
[3]Downstream = mine access road near 8-South Waste Rock Dump.

Source: Marigold Mining Company 1998.

The unnamed easternmost drainage in the Marigold Mine vicinity (Map 3-1) has a watershed area of approximately 8 square miles, with headwaters in the North Peak area of Battle Mountain. As it opens onto the alluvial fan system, this ephemeral system disperses into a network of numerous small drainages with no distinct streambed evident over most of the fan surface in the project area. In the extreme eastern part of Section 16, T33N, R43E, and diagonally across Section 10, T33N, R43E, a small channel system does occur. Although portions of this watershed lie within the current project area, no disturbance is planned to occur within it (JBR 1998).

Three springs are located within the unnamed easternmost drainage area. Mud Spring and an unnamed spring approximately 800 feet to its northwest lie within the project boundary in Section 20, T33N, R43E. Ames Spring lies outside of the project area in the southwest quarter of the southeast quarter, Section 16 T33N, R43E. There are no other identified surface water features within the project boundary or nearby.

**Surface Water Quality**

State water quality standards are shown in Table 3-1. Water quality data for samples retrieved from Trout Creek in the spring and summer of 1998 are subsequently shown in Table 3-2. Sampling results indicate that water quality upstream and downstream of the site is generally within Nevada drinking water standards, and is within state agricultural standards. Manganese and iron, which have drinking water standards based on discoloration and taste as opposed to health, are exceeded both upstream and downstream of the site. These constituents show increase in concentration from upstream to downstream. The causes of this are currently unknown.

Surface water quality monitoring was conducted at Cottonwood Creek approximately 2.0 miles south of the Marigold Mine in Section 25 (BLM 1998). This monitoring indicated that state water quality standards for aquatic and agricultural uses were met for all constituents during the 2-year monitoring period. No exceedences were identified (BLM 1998).

**Waters of the United States**

Waters of the United States (U.S.) are defined as: 1) all waters that are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters that are subject to the ebb and flow of the tide; 2) all interstate waters including interstate wetlands; 3) all other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds; the use degradation or destruction of which could affect interstate or foreign commerce, including any such waters: i) that are or could be used by interstate or foreign travelers for recreational or other purposes; or ii) from which fish or shellfish are or could be used for industrial purposes by industries or foreign commerce; or iii) that are used or could be used for industrial purposes by industries in interstate commerce; or iv) all impoundments of waters otherwise defined as waters of the U.S. under the definition; or v) tributaries of waters as described above; or vi) the territorial seas; or vii) wetlands adjacent to waters (other than waters that are themselves wetlands) as described above; and viii) not prior coverted cropland (33 CFR 328[a] and 40 CFR 230.3[s]).

Waters of the U.S., including wetlands, subject to Section 404 of the Clean Water Act were partially delineated in the project area in 1993 (Gibson and Skordal 1993). Approximately 3.7 acres of waters of the U.S. were delineated, and approximately 2.82 acres of these waters were determined to have been previously impacted by mining activities within the project area, mostly due to the existing Trout Creek diversion. Appropriate permits have been approved for past activities on the project area (COE 1993), and would be sought for future disturbances to waters of the U.S.

The 1993 survey did not extend over the entire proposed mine expansion area, but provided

sufficient information to allow additional assessments to be made. Given the information presented in the earlier report, a total of 9.7 acres considered to be waters of the U.S. occurs within the current project area overall. Approximately 1.3 acres of waters of the U.S. would be disturbed by the Cottonwood Creek diversion, bringing the total disturbed acreage of waters of the U.S. up to 4.12 acres for the entire project area. GMMC has committed to completing the delineations of Waters of the U.S. prior to any disturbance in the areas. All appropriate plans and permits also would be approved prior to disturbance.

#### 3.1.1.3 Water Rights

Table 3-3 indicates the water rights, sources, and usage in the project vicinity. A number of the rights, particularly the oldest certificated rights for irrigation or mining, occur several miles from the project boundary.

#### 3.1.1.4 Groundwater Resources

The project area lies south of the Humboldt River in an area that has received extensive hydrologic study related to mine dewatering and the Valmy Power Station production water use. Studies related to mine dewatering and groundwater hydrology have been conducted in the area for the Lone Tree Mine by Hydrologic Consultants, Inc. (HCI 1994, 1996a, 1996b, 1996c). Studies related to water sources for the North Valmy Power Station were mainly conducted by Guyton and Associates (Guyton 1976a, 1977a, 1977b, 1977c). Groundwater studies related to the Marigold Mine include the evaluation of water supply wells by Water Management Consultants, Inc. (WMC 1992) and an evaluation of Lone Tree Mine dewatering on water levels in the Marigold Mine area (WMC 1994). Three water wells (WW1, WW2, and WW3) currently supply 450 gpm to the Marigold Mine (see Map 3-2). All three are screened in bedrock and alluvium. Evaluations of the existing tailings impoundment hydrology and seepage from the tailings to groundwater at the Marigold Mine have been completed by WMC (1993, 1994) and Hydro-Engineering (1995).

**Conceptual Hydrologic Model**

The project area lies within the Humboldt River drainage in north-central Nevada. Groundwater recharge in the vicinity of the project is derived from infiltration of precipitation in the bedrock highlands, infiltration of stream flow during periods of high flow in the late spring and during storms, from the Humboldt River, and from deep interbasin flow along faults and in carbonate bedrock. The Humboldt River loses approximately 8 cfs as it flows from the town of Battle Mountain northwestward across the project area (BLM 1995). Recharge from infiltration of precipitation in the bedrock highland areas is difficult to quantify because of the variable nature of fracturing in the bedrock and the considerable range in slope steepness and vegetative cover in the highland areas. However, an isotopic study for the water sources at the nearby Lone Tree Mine has shown that the bedrock highlands are an important source of groundwater in the project area. Recharge from precipitation on the valley floors is probably low due to the semiarid nature of this part of Nevada and the ability of the native vegetation to evapotranspire the water back to the atmosphere.

Discharge of groundwater is more difficult to estimate in the project area. Groundwater can come to the surface as springs and the abundance of springs in the highland areas and along the base of the highland areas suggest that this is an important source of groundwater discharge. Domestic, agricultural, and industrial use of groundwater is high in the project area. Shallow alluvial groundwater is used for crop irrigation. Most of this irrigation, however, is north of the Humboldt River. The North Valmy Power Station removes about 2,000 gpm of alluvial groundwater from the south side of the Humboldt River between the power plant and the town of Battle Mountain (WMC 1994). The town of Battle Mountain is permitted for up to 4,107 acre-feet per year (2,545 gpm) of groundwater for municipal use

## Table 3-3
## Water Rights in the Project Vicinity

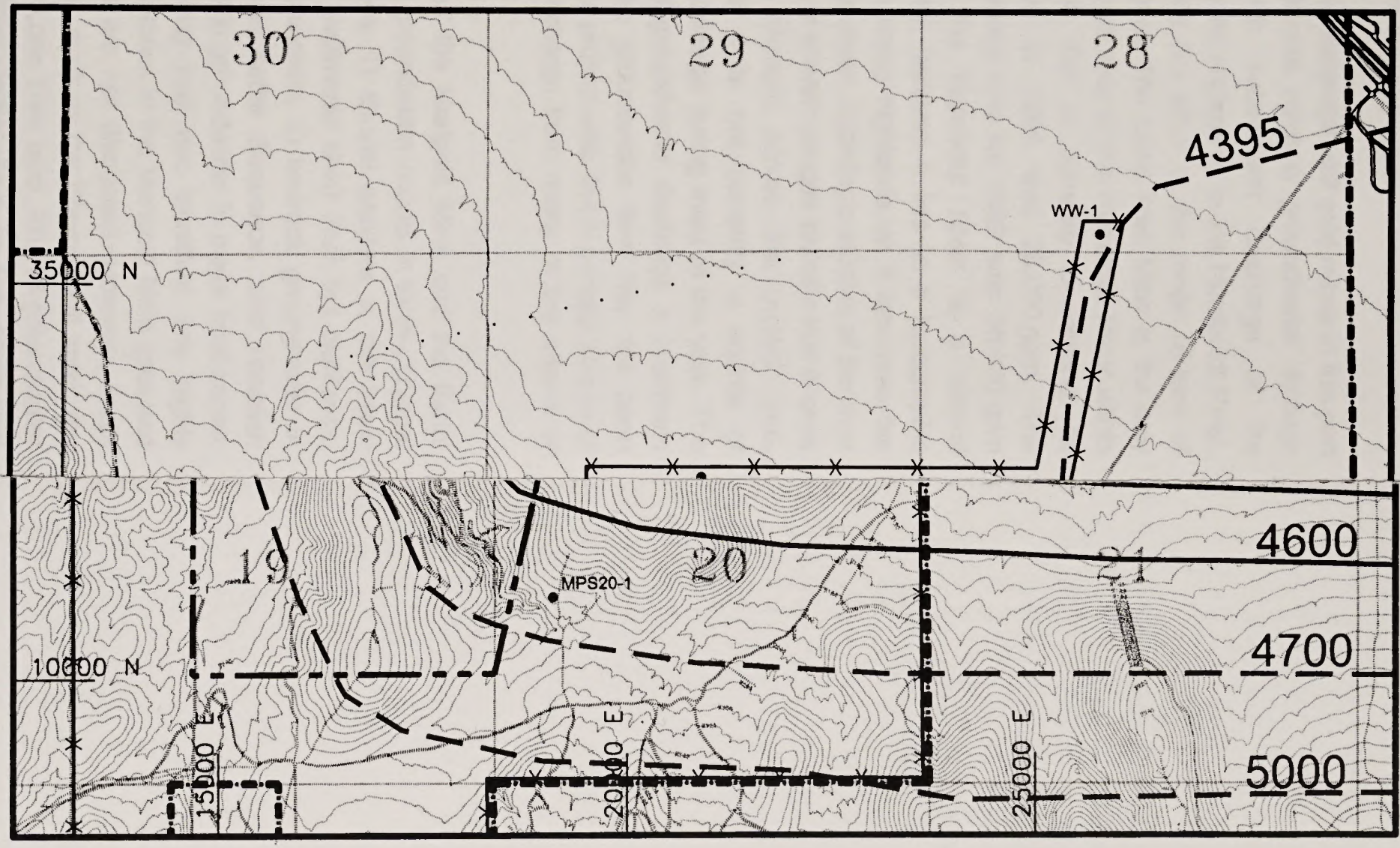
| Owner | Application | Point of Diversion (Legal Description) | Filing Status | Source | Diversion Rate (cfs)[1] | Use | Annual Duty (af[2]; Mg[3]) |
|---|---|---|---|---|---|---|---|
| F. Marker | 2216 | T32N, R43E | Certificated | Trout Creek | 0.1661 | Irrigation | 61.84 af |
| C.Marker | 2324 | T33N, R43E, Sec. 30 | Certificated | Trout Creek | 0.1496 | Irrigation | 65.04 af |
| A. Marker | 2513 | T33N, R43E, Sec. 16 | Certificated | Desert Spring | 0.10 | Irrigation | 40 af |
| Buffalo Valley Mines, Inc. | 2621 | T32N, R42E, Sec. 26 | Certificated | Mill Canyon Spring | 0.16 | Mine | 0 |
| F. Marker | 3282 | T32N, R42E, Sec. 12 | Certificated | Cottonwood Creek | 0.3273 | Irrigation | 160 af |
| F. Marker | 01898 | T32N, R42E, Sec. 12 | Vested | Cottonwood Creek | --- | Irrigation | 132 af |
| G.C. Partee, Trust | 10701 | T33N, R43E, Sec. 31 | Certificated | Trout Creek | 0.05 | Mine | 0 |
| Venturacci Ranch | V03744 | T33N, R43E, Sec. 32 | Vested | Willow Creek | 1.00 | Stock | 0 |
| Venturacci Ranch | V04636 | T33N, R42E, Sec. 20 | Vested | Ames Spring<br>Mud Spring | 0.50 | Stock | 0 |
| Marigold Mining Co. | 58020 | T33N, R43E, Sec. 4 | Permitted | Underground | | Mine | 8 well rights |
| Marigold Mining Co. | 58021 | T33N, R43E, Secs. 4/8 | Permitted | Underground | | Mine | commingled: |
| Marigold Mining Co. | 58022 | T33N, R43E, Sec. 8 | Permitted | Underground | | Mine | not to exceed |
| Marigold Mining Co. | 58023 | T34N, R43E, Sec. 28 | Permitted | Underground | | Mine | 828.64 Mg/yr |
| Marigold Mining Co. | 58024 | T34N, R43E, Sec. 33 | Permitted | Underground | | Mine | combined duty. |
| Marigold Mining Co. | 51463 | T34N, R43E, Sec. 28 | Permitted | Underground | | Mine | |
| Marigold Mining Co. | 51884 | T34N, R43E, Sec. 33 | Permitted | Underground | | Mine | |
| Marigold Mining Co. | 51886 | T33N, R43E, Sec. 4 | Permitted | Underground | | Mine | |
| Santa Fe Pacific Gold Corp. | 60606 | T32N, R43E, Sec. 7 | Permitted | Underground | 0.11 | Other | 60 af |
| Newmont Gold Co. | 62320 | | Permitted | Underground | | | |

[1]cfs = cubic feet/second.
[2]af = acre feet.
[3]Mg = million gallons.

Source: Nevada Division of Water Resources 1998, Glamis Marigold Mining Company 1999.

LEGEND

- Private Land/Public Land Claim Boundary
- Current Permit Boundary
- Proposed Permit Boundary
- Water Level Surface (Feet)
- Estimated Water Level Surface (Feet)
- Well or Boring




0 5000 Feet

Marigold Mine

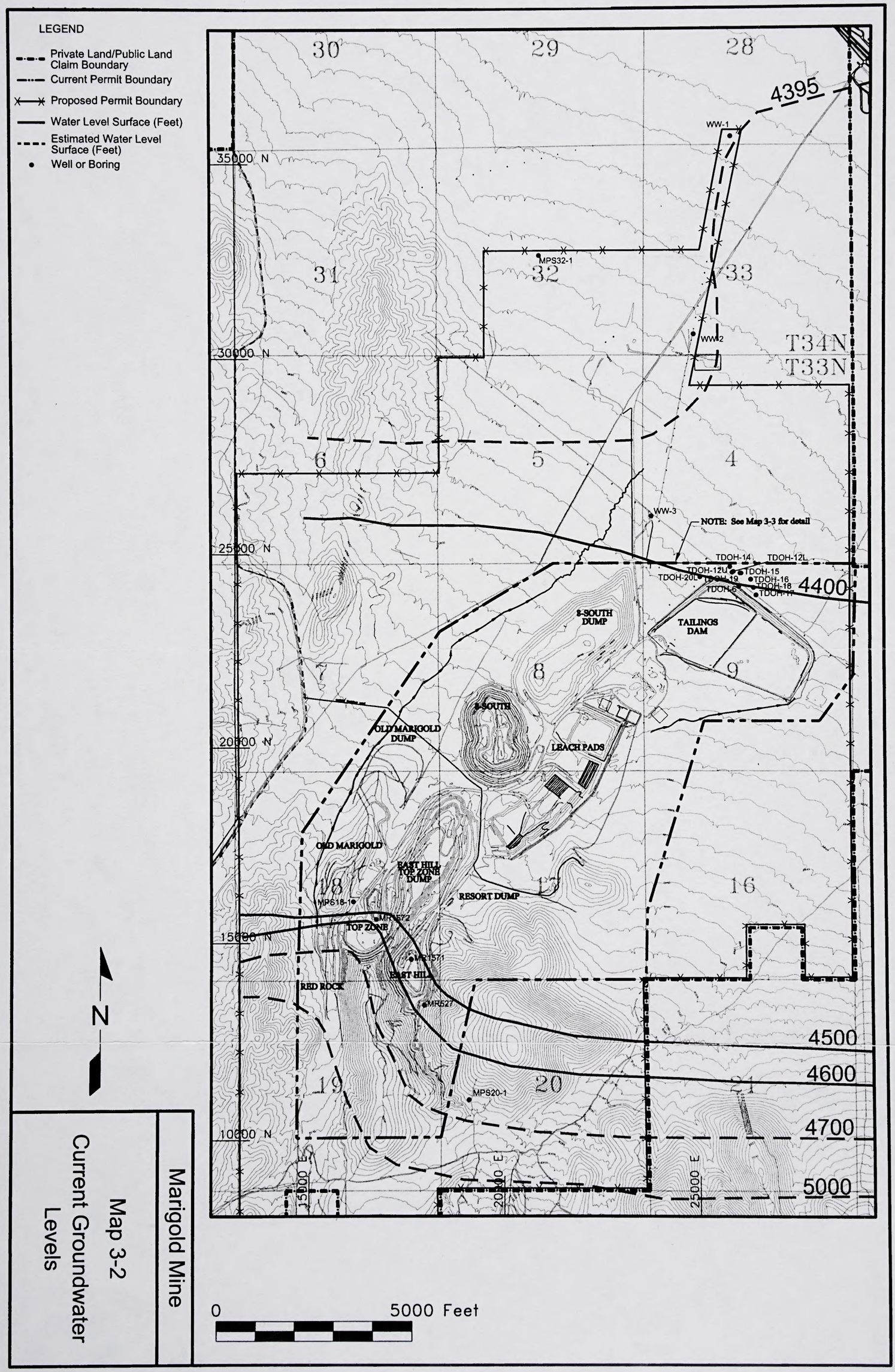
Map 3-2
Current Groundwater Levels

## Table 3-3
## Water Rights in the Project Vicinity

| Owner | Application | Point of Diversion (Legal Description) | Filing Status | Source | Diversion Rate (cfs)[1] | Use | Annual Duty (af[2]; Mg[3]) |
|---|---|---|---|---|---|---|---|
| F. Marker | 2216 | T32N, R43E | Certificated | Trout Creek | 0.1661 | Irrigation | 61.84 af |
| C.Marker | 2324 | T33N, R43E, Sec. 30 | Certificated | Trout Creek | 0.1496 | Irrigation | 65.04 af |
| A. Marker | 2513 | T33N, R43E, Sec. 16 | Certificated | Desert Spring | 0.10 | Irrigation | 40 af |
| Buffalo Valley Mines, Inc. | 2621 | T32N, R42E, Sec. 26 | Certificated | Mill Canyon Spring | 0.16 | Mine | 0 |
| F. Marker | 3282 | T32N, R42E, Sec. 12 | Certificated | Cottonwood Creek | 0.3273 | Irrigation | 160 af |
| F. Marker | 01898 | T32N, R42E, Sec. 12 | Vested | Cottonwood Creek | --- | Irrigation | 132 af |
| G.C. Partee, Trust | 10701 | T33N, R43E, Sec. 31 | Certificated | Trout Creek | 0.05 | Mine | 0 |
| Venturacci Ranch | V03744 | T33N, R43E, Sec. 32 | Vested | Willow Creek | 1.00 | Stock | 0 |
| Venturacci Ranch | V04636 | T33N, R42E, Sec. 20 | Vested | Ames Spring<br>Mud Spring | 0.50 | Stock | 0 |
| Marigold Mining Co. | 58020 | T33N, R43E, Sec. 4 | Permitted | Underground | | Mine | 8 well rights |
| Marigold Mining Co. | 58021 | T33N, R43E, Secs. 4/8 | Permitted | Underground | | Mine | commingled: |
| Marigold Mining Co. | 58022 | T33N, R43E, Sec. 8 | Permitted | Underground | | Mine | not to exceed |
| Marigold Mining Co. | 58023 | T34N, R43E, Sec. 28 | Permitted | Underground | | Mine | 828.64 Mg/yr |
| Marigold Mining Co. | 58024 | T34N, R43E, Sec. 33 | Permitted | Underground | | Mine | combined duty. |
| Marigold Mining Co. | 51463 | T34N, R43E, Sec. 28 | Permitted | Underground | | Mine | |
| Marigold Mining Co. | 51884 | T34N, R43E, Sec. 33 | Permitted | Underground | | Mine | |
| Marigold Mining Co. | 51886 | T33N, R43E, Sec. 4 | Permitted | Underground | | Mine | |
| Santa Fe Pacific Gold Corp. | 60606 | T32N, R43E, Sec. 7 | Permitted | Underground | 0.11 | Other | 60 af |
| Newmont Gold Co. | 62320 | | Permitted | Underground | | | |

[1]cfs = cubic feet/second.
[2]af = acre feet.
[3]Mg = million gallons.

Source: Nevada Division of Water Resources 1998, Glamis Marigold Mining Company 1999.




Marigold Mine

Map 3-2
Current Groundwater Levels



(Guyton 1977a). Many open-pit gold mines in this part of northern Nevada remove groundwater through dewatering, with subsequent discharge of the groundwater to the surface or to the Humboldt River. Dewatering rates are often in the range of tens of thousands of gpm. The Lone Tree Mine is the only mine on the south side of the Humboldt River within the study area that is currently dewatering. Its dewatering rate in 1994 was 23,000 gpm. The average dewatering rate for 1999 was 36,000 gpm (BLM 1995). The Humboldt River is a natural groundwater sink because it lies in a topographic valley between many highlands as it traverses the project area. However, hydrologic studies of the river and monitoring of stream gauges indicate that it loses water to the alluvium across the project area, suggesting that it is not currently a source of groundwater discharge during most of the year. The other source of groundwater discharge is interbasin flow. This deep groundwater flow has not been quantified for the project area, but is a major source of groundwater discharge from many of the basins of Nevada.

In the vicinity of the Marigold Mine and the Battle Mountain area, groundwater occurs in three principal types of aquifers: 1) alluvial aquifers in the basin sediments and sediments shed from the highlands, mainly Battle Mountain; 2) bedrock groundwater in the Valmy, Antler/Battle Sequence, and Havallah formations; and 3) groundwater in major fault zones. Exploration drilling has not identified any highly permeable fault zones in the Marigold Mine area and therefore, faults are not discussed. However, faults containing water, such as the Wayne fault zone, are known from the Lone Tree area. Alluvial groundwater and bedrock groundwater flow to the north and northwest from the Battle Mountain area toward the Humboldt River. Groundwater in fault zones is more difficult to quantify and the direction of movement of groundwater in faults is uncertain.

**Alluvial Groundwater**. The alluvial hydrostratigraphy of the project area and vicinity consists of three principal components: 1) an upper alluvial layer that interacts with the Humboldt River, 2) lake beds that date from the Pleistocene that often act as aquitards preventing the movement of water between the upper and lower alluvial layers, and 3) a lower alluvial layer that can be up to 2,000 feet thick in the project area and contains waterbearing coarse gravel zones intermixed with less permeable finer-grained beds (Guyton 1977a). The upper alluvial layer is found throughout the project area and has been hydraulically evaluated for permeability at the Lone Tree Mine (HCI 1994). Table 3-4 presents a summary of the permeability of the various hydrostratigraphic units in the Marigold – Lone Tree area. The upper alluvial layer ranges in thickness from a few feet to about 200 feet and has a hydraulic conductivity that ranges from less than 1.0 foot/day to around 4.0 feet/day.

The Pleistocene lake beds can be on the order of 5 to 100 feet thick in the vicinity of the Humboldt River (Guyton 1977a). These lake beds may be present in the Marigold Mine area as a thick tan clay found at depths ranging from 85 to 320 feet in the production water wells (WMC 1992). Here the lake beds are 30 to 175 feet thick and lie above the bedrock in the northern part of the mine area. The lake beds have a low permeability and act as an aquitard separating the upper and lower alluvial layers (Guyton 1977a).

The lower alluvial layer is found beneath the Humboldt River and is the principal source of water for the Valmy Power Plant. The permeability of this hydrostratigraphic unit varies considerably and ranges up to a few hundred feet per day. Water is derived from thick zones of gravel and sand that are interbedded with silts and clays.

In the vicinity of the Marigold Mine, especially to the north of the mine between Section 5, T33N, R43E and the town of Valmy, the upper alluvial layer contains water. Immediately north of the tailings impoundment, the water table in the alluvial aquifer is currently around 4,400 feet (amsl) (Map 3-2). For the most part, saturation in the alluvial aquifer is fairly uniform from the mine area to Valmy. However, production water well WW-2, which provides water to the mine, does contain dry alluvium. It is believed that

Table 3-4
Summary of Aquifer Tests Conducted for the
Lone Tree and Marigold Mines

| Hydrostatigraphic Unit | Tested Well | Well Depth (feet) | Initial Depth to Water (feet) | Hydraulic Conductivity (feet/day) | Transmissivity (feet squared/day) | Storage Coefficient |
|---|---|---|---|---|---|---|
| | WW-3 | 434 | 24 | .05* - .5* | 18.8* - 603* | 6.00E-03 |
| LONE TREE | WW-4 | 625 | 148 | 237 | 101,304 | |
| ALLUVIUM | WW-5 | 620 | 50 | 4.4 | 1,876 | |
| | WW-5/WW-6 | 655 | 308 | 0.08* | 33.5* | 6.00E-03 |
| | | | | | | |
| | WW-4 | 625 | 148 | 35* - 333 | 17,152* - 71,958 | 2.0E-6 to 5.0E-3 |
| LONE TREE | WW-5 | 620 | 50 | 99 - 822 | 21,440 - 469,000 | |
| VALMY | WW-12 | 1090 | 285 | 26* | 18,492* | |
| | WW-5/WW-6 | 655 | 308 | 28* | 24,790* | 1.00E-03 |
| | | | | | | |
| LONE TREE ANTLER | WW-4 | 625 | 148 | 224 | 131,052 | |
| | | | | | | |
| | WW-2 | 593 | 73 | 13* - 14* | 7,504* - 7,906 | 3.00E-03 |
| LONE TREE | WW-4 | 625 | 148 | 173 | 96,882 | |
| HAVALLAH | WW-5 | 620 | 50 | 2386 | 1,393,600 | |
| | WW-13 | 1235 | 731 | 5* | 4,958* | |
| | PMW-4,5,7 | | 268-565 | | 40 - 268 | |
| | WW-5/WW-6 | 655 | 308 | 8.6* | 7,718* | 3.00E-03 |
| | | | | | | |
| LONE TREE | WW-4 | 625 | 148 | 68 - 202 | 39,128 - 294,800 | 6.0E-3 to 1.0E-2 |
| WAYNE FAULT ZONE | WW-5 | 620 | 50 | 484 - 921(575)* | 321,600* | 3.0E-5 to 6.0E-2 |
| | WW-5/WW-6 | 655 | 308 | 304* | 294,800* | 9.00E-03 |
| | | | | | | |
| MARIGOLD | WW-1 | 453 | 126 | 12 - 20 (102)*a | 3,360 - 5,235 | 26,885 |
| VALMY/BEDROCK | WW-2 | 600 | 204 | 5.8 (14 - 43)*a | 1,611 | 4,086 - 12,112 |
| | WW-3 | 700 | 283 | 1.6 (11 - 69)*a | 652 | 4,502 - 27,683 |
| | TDOH-12L | | | 0.53 | 76.5 | |
| | TDOH-12U | | | 1 | 146 | |
| ALLUVIUM | TDOH-15 | | | 4.2 | 607 | |
| | TDOH-16 | | | 1.3 | 189 | |
| | TDOH-17 | | | 0.14 | 20.9 | |
| | | | | | | |

Notes: * indicates good data to support value
Source for Lone Tree data (BLM 1995, Table 3-18); Marigold data source (WMC 1992)
( )*a indicates hydraulic conductivity calculated from recovery data for Marigold wells

the aquifer in the alluvium is mostly unconfined, but the presence of finer-grained beds locally can lead to local semi-confined conditions in the alluvial aquifer within and north of the mine area. Groundwater in the alluvial aquifer flows to the north and northwest.

**Bedrock Groundwater**. Bedrock groundwater occurs in the Valmy, Antler/Battle Sequence, and Havallah formations. In the mine area, bedrock groundwater has been intercepted in exploration drill holes. Table 3-5 summarizes the data on bedrock groundwater in the mine area. Bedrock groundwater flows generally from Battle Mountain northward toward the Humboldt River. Bedrock groundwater levels just south of the Marigold Mine in the Valmy formation have been measured at 5,050 feet (amsl). In the vicinity of the southern pits (Top Zone, Red Rock, East Hill) the bedrock groundwater has a potentiometric surface in the range of 4,500 to 4,700 feet (amsl) as shown on Map 3-2. In Section 8 in the vicinity of 8-South and 8-North pits, the bedrock groundwater has an estimated elevation of about 4,400 feet (amsl). In the vicinity of proposed 5-North Pit, the bedrock groundwater is estimated at 4,450 feet (amsl). Production water well WW-3, which is screened mainly in bedrock, has a water level of approximately 4,400 feet (amsl). These are current bedrock water levels. Historical evaluations of water levels at the Marigold Mine from 1992 to 1994 (WMC 1994) indicate that water levels in the alluvium and the bedrock have been dropping at a rate of about 7.0 to 7.5 feet per year. Existing pits and permitted pit expansions at the Marigold Mine are expected to remain dry, with the potential exception of the 8-South Pit, which may have a 10-foot deep pit lake during the winter months (see Table 3-6). Dewatering has not been needed at the existing Marigold Mine pits.

The hydraulic properties of the bedrock hydrostratigraphic units were evaluated at the Lone Tree Mine in preparation for a numerical groundwater model. These conductivity estimates are shown in Table 3-4. No aquifer tests have been run on bedrock aquifers in the vicinity of the existing Marigold Mine pits. Limited tests were run on the production water wells, which are screened mostly in bedrock (WMC 1992). These data are included in Table 3-4.

## Groundwater Movement

Groundwater movement across the Marigold Mine can be inferred from the water table contours presented in Map 3-2. The contours were interpreted from monitor well water level data and represent an approximate "average" for water levels in the alluvial aquifer and the bedrock aquifer. Groundwater flows generally from the Battle Mountain highland north to northwestward toward the Humboldt River. Within about 2 miles of the Lone Tree Mine, dewatering has resulted in water movement to the northwest toward the Lone Tree Mine.

The alluvial aquifer water table shows a gradient that generally becomes more shallow northward from the mine area to the Humboldt River. The bedrock water table is more irregular. There appears to be a local high near the Top Zone and East Hill pits (see Map 3-2). The origin of this bedrock groundwater high is uncertain. With the possible exception of the groundwater in the Top Zone and East Hill pit areas, bedrock groundwater flows to the north through the Marigold Mine area following a gradient that rapidly becomes more shallow from south to north across the mine area.

## Groundwater Quality

Monitor wells installed north of the existing tailings impoundment are the main source of groundwater quality data for the alluvial aquifer. The three production water wells are the main source of groundwater quality data for the bedrock aquifer. These water quality data are summarized in Table ***B-6*** (see Appendix ***B***). Wells installed for the North Valmy Power Station provide water quality data for the deep alluvial aquifer south of the Humboldt River.

Groundwater in the deep alluvial aquifer south of the Humboldt River is distinct in that it is primarily sodium bicarbonate-dominated water with elevated sulfate

## Table 3-5
## Marigold Mine Monitor Well Water Levels

| Well Name | Date Installed | Hydrologic Unit Screened | Initial Water Level (feet amsl) | Current Water Level | | Average Annual Decline Since 1992 (feet/year) | Est. Pre-1992 Water Level (feet amsl) | Comments |
|---|---|---|---|---|---|---|---|---|
| | | | | Date | Water Level | | | |
| **BEDROCK WELLS** | | | | | | | | |
| MPS-18-1 | 12/16/97 | Bedrock | 4406.2 | 6/1/99 | 4391.3 | 9.9 | 4470 | Pre-dewatering water level est. by extrapolating |
| | | | | | | | | observed decline backwards for 8 years |
| MPS-20-1 | 2/25/98 | Bedrock | 4667.6 | 1998 | dry | 7.4* | 4719.4 | Pre-dewatering water level est. by extrapolating |
| | | | | | | | | avg site decline back 7 years. |
| MR-527 | 4/7/93 | Bedrock | 4487.5 | | plugged | 7.4* | 4502.3 | Pre-dewatering water level est. by extrapolating |
| | | | | | | | | avg site decline back 2 years. |
| MR-1571 | 6/21/99 | Bedrock | 4561.9 | | | 7.4* | 4621.1 | Pre-dewatering water level est. by extrapolating |
| | | | | | | | | avg site decline back 8 years. |
| MR-1572 | 6/21/99 | Bedrock | 4593.4 | | | 7.4* | 4652.6 | Pre-dewatering water level est. by extrapolating |
| | | | | | | | | avg site decline back 8 years. |
| WW-1 | 3/10/88 | Alluvial/Bedrock | 4431.2 | Nov-96 | 4395 | 7.3 | 4431.2 | Initial water level preceeds Lone Tree dewatering. WW-1 is a production well |
| | | | | | | | | |
| WW-2 | 1/30/89 | Bedrock | 4435.5 | Nov-96 | 4392 | 8.4 | 4435.5 | Initial water level preceeds Lone Tree dewatering. WW-2 is a production well |
| | | | | | | | | |
| WW-3 | 3/21/89 | Alluvial/Bedrock | 4438 | Jul-94 | 4410.4 | 6.2 | 4438 | Initial water level preceeds Lone Tree dewatering. WW-3 is a production well |
| **ALLUVIAL WELLS** | | | | | | | | |
| TDOH-6 | 12/14/92 | Alluvial | 4433.2 | Dec-95 | 4421.9 | 6.7 | 4439.7 | Pre-dewatering water level est. by extrapolating |
| | | | | | | | | observed decline back 1 year fm 1992. |
| TDOH-12L | 8/12/93 | Alluvial | 4428.5 | 6/10/98 | 4391.5 | 7.6 | 4443.7 | Pre-dewatering water level est. by extrapolating |
| | | | | | | | | observed decline back 2 years fm 1993. |
| TDOH-12U | 9/14/93 | Alluvial | 4428.2 | Nov-96 | 4404.7 | 7.4 | 4443 | Pre-dewatering water level est. by extrapolating |
| | | | | | | | | observed decline back 2 years fm 1993. |
| TDOH-15 | 9/14/93 | Alluvial | 4428 | Jun-98 | 4404.7 | 4.9 | 4437.8 | Pre-dewatering water level est. by extrapolating |
| | | | | | | | | observed decline back 2 years fm 1993. |
| TDOH-16 | 9/14/93 | Alluvial | 4428 | Jun-98 | 4398.2 | 6.3 | 4440.5 | Pre-dewatering water level est. by |

Table 3-5 (Continued)

| Well Name | Date Installed | Hydrologic Unit Screened | Initial Water Level (feet amsl) | Current Water Level | | Average Annual Decline Since 1992 (feet/year) | Est. Pre-1992 Water Level (feet amsl) | Comments |
|---|---|---|---|---|---|---|---|---|
| | | | | Date | Water Level | | | |
| | | | | | | | | extrapolating |
| | | | | | | | | observed decline back 2 years fm 1993. |
| TDOH-17 | 9/14/93 | Alluvial | 4425.1 | Jun-98 | 4394.4 | 6.5 | 4438.1 | Pre-dewatering water level est. by extrapolating |
| | | | | | | | | observed decline back 2 years fm 1993. |
| TDOH-18L | 5/5/97 | Alluvial | 4395.8 | Jun-98 | 4385.6 | 9.4 | 4451.5 | Pre-dewatering water level est. by extrapolating |
| | | | | | | | | observed decline back 7 yrs. |
| TDOH-19L | 5/5/97 | Alluvial | 4395.2 | Jun-98 | 4384.7 | 9.7 | 4452.5 | Pre-dewatering water level est. by extrapolating |
| | | | | | | | | observed decline back 7 yrs. |
| TDOH-20L | 5/6/97 | Alluvial | 4396.4 | Jun-98 | 4393.5 | 8.3 | 4445.5 | Pre-dewatering water level est. by extrapolating |
| | | | | | | | | observed decline back 7 yrs. |
| MPS-32-1 | 2/21/98 | Alluvial | 4375 | 1/5/99 | 4370.9 | 4.5 | 4406.9 | Pre-dewatering water level est. by extrapolating |
| | | | | | | | | avg.site decline back 8 years. |

Note: 7.4* = average site water level decline. Applied to wells with no established water level decline rate.
1992 was chosen as reference year because this was year Lone Tree Mine began dewatering.

Source: Marigold Mine 1999.

## Table 3-6
## Pit Bottom Elevations and Pit Water Levels

| Pit Designation | Mine Coordinate Range for Pit | Proposed Bottom | | Bedrock Water Levels (Estimated Pre-1992 Levels) (feet amsl) | Bedrock Water Levels (Estimated Current Levels) (feet amsl) | Estimated Maximum Pit Lake Depth (feet) | Dewatering Required | Comments |
|---|---|---|---|---|---|---|---|---|
| | | Plan (feet amsl) | Approved (feet amsl) | | | | | |
| **5-N** | 26,000 - 29,000N<br>19,000 – 22,000E | 4,450 | Not Yet Approved | 4,438 | 4,395 | 0 | No | Based on WW-3. Water level 12 feet below pit bottom |
| **8-N** | 22,000 - 25,000N<br>18,000 – 21,000E | 4,470 | Not Yet Approved | 4,450 (based on interpreted contours) | 4,400 | 0 | No | Water level interpreted between MPS18-1 and TDOH (tailings) wells. Pit bottom to be at least 20 feet above pre-mining water level |
| **8-S** | 19,000 - 25,000N<br>18,000 – 22,000E | 4,440 | 4,440 | 4,450 (based on interpreted contours) | 4,400 | 10 | No | Pit lake possible, but not likely based on past history of dry pit during mining. Water level interpreted between MPS 18-1 and TDOH (tailings) wells |
| **East Hill - North** | 13,000 - 15,000N<br>16,000 – 18,000E | 4,700 | 4,700 | 4,600 –4,650 (estimated at 4,620) | 4,562 | 0 | No | Water level 50-100 feet below pit bottom based on MR 1571. |
| **East Hill - South** | 12,000 - 14,000N<br>16,000 – 18000E | 4,820 | 4,700 | 4,600 –4,650 (estimated at 4,620) | 4,562 | 0 | No | Water level 50-100 feet below pit bottom based on MR 1571. |
| **Old Marigold** | 17,000 - 19,000N<br>15,000 – 17,000E | 4,910 | 4,890 | 4,460 | 4,406 | 0 | No | Based on MPS 18-1 |
| **Top Zone –North** | 15,000 - 18,000N | 4,800 | 4,800 | 4,500-4,700 (estimated at 4,650) | 4,593 | 0 | No | Based on MR 1572 |
| **Top Zone – South** | 15,000 - 18,000E | 4,740 | 4800 | 4,500-4,700 (estimated at 4,650) | 4,593 | 0 | No | Based on MR 1572 |
| **Red Rock - North** | 12,000 - 15,000N | 5,000 | 4,920 | 4,700-4,750 | 4,600 – 4,700 | 0 | No | Water level extrapolated from contoured data |
| **Red Rock - South** | 15,000 - 16,000E | 4,980 | Not Yet Approved | 4,700-4,750 | 4,600 – 4,700 | 0 | No | |

Source: Marigold Mine.

and chloride levels. Sodium ranges from approximately 40 to 630 mg/l. Calcium is below 40 mg/l. Sulfate ranges from 35 to 400 mg/l and chloride from 15 to 200 mg/l. The studies of Guyton (1977b) showed that the water quality becomes more saline with depth. TDS range from 200 to 1,700 mg/l. The temperature of the water is generally between 60 to 75°F, but some wells intercepted groundwater with temperatures ranging from approximately 80 to 115°F.

The water quality in the Marigold production wells and in the monitor wells to the north of the tailings impoundment is similar. These waters are calcium bicarbonate-dominated with a TDS in the range of approximately 200 to 450 mg/l. Sulfate ranges from as low as 8 mg/l to a maximum around 380 mg/l. Chloride is generally below 100 mg/l. The pH is between 6.2 and 7.84. In the production water wells, arsenic was elevated with values in the range of 0.03 to 0.07 mg/l. The similarity in water quality between the bedrock aquifer in the production wells and the alluvial aquifer to the north of the tailings impoundment suggests that these two aquifers probably communicate in the project area.

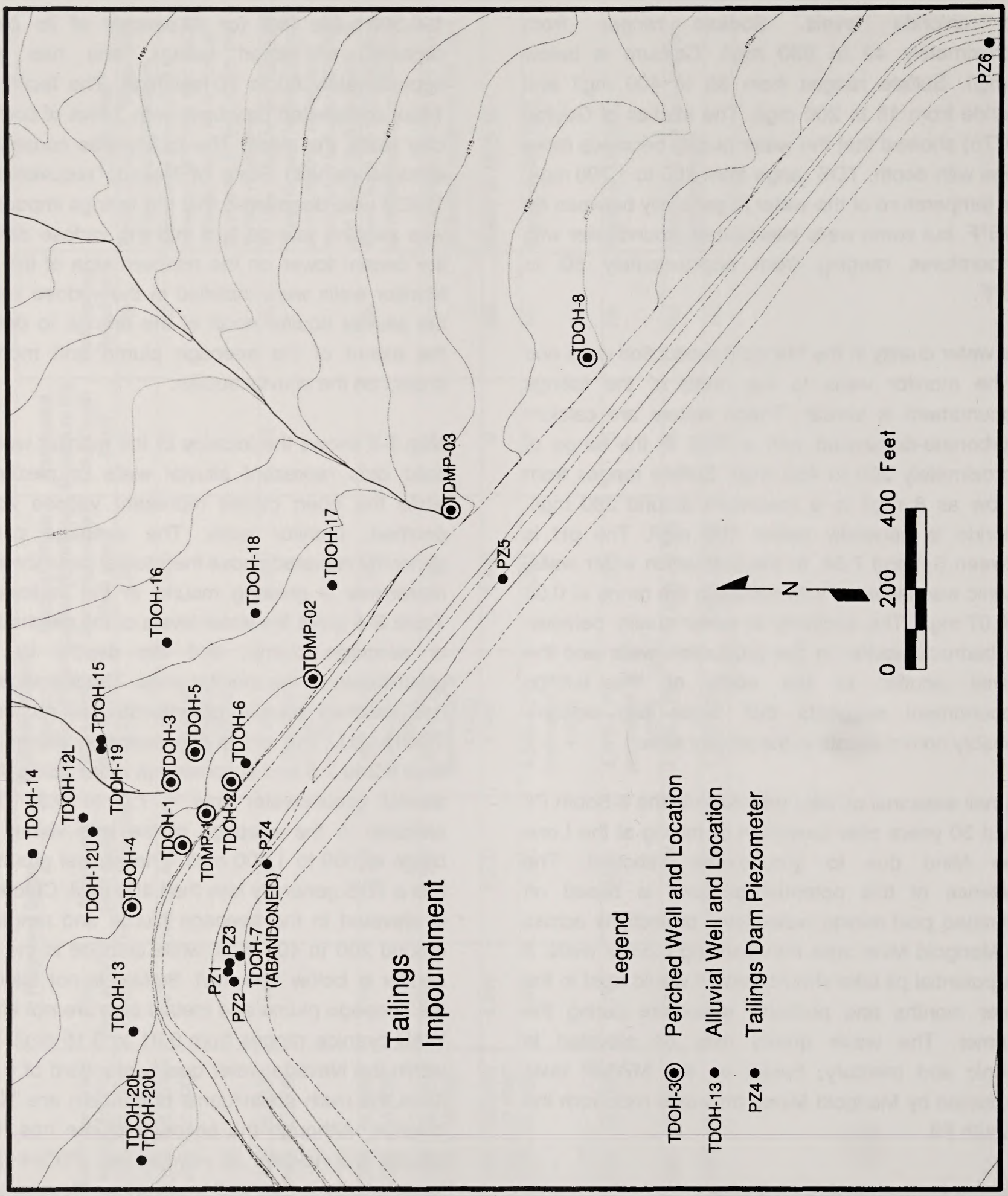
A small seasonal pit lake may form in the 8-South Pit about 30 years after cessation of mining at the Lone Tree Mine due to groundwater rebound. The existence of this potential pit lake is based on estimated post-mining water level projections across the Marigold Mine area from existing monitor wells. If this potential pit lake should form, it would exist in the winter months and probably evaporate during the summer. The water quality may be elevated in arsenic and mercury, based on the MWMP tests conducted by Marigold Mines on waste rock from the 8-South Pit.

**Tailings Impoundment Hydrology**

The Marigold Mine currently operates a tailings impoundment located in Section 9, T33N, R43E. This tailings impoundment was constructed in 1988 and is not lined with synthetic materials. Currently, the facility occupies about 180 acres, contains 196,500 cubic feet (or ***69*** percent of its permitted capacity) of stored tailings, and has a dam approximately 60 to 70 feet high. The facility has a 1-foot compacted clay base with 3 feet of compacted clay along the sides. The facility was constructed in accordance with State of Nevada requirements. In 1992 it was discovered that the tailings impoundment was seeping tailings fluid into the vadose zone near the decant tower on the northern side of the facility. Monitor wells were installed in the vadose zone and the alluvial aquifer north of the tailings to determine the extent of the seepage plume and monitor its impact on the alluvial aquifer.

Map 3-3 shows the location of the monitor wells. The solid dots represent alluvial wells or piezometers, while the open circles represent vadose zone, or perched, monitor wells. The seepage plume is generally elevated above the alluvial groundwater and represents a growing mound in the vadose zone. Table ***B-6*** gives the water levels of the perched water, or seepage plume, and the depths to alluvial groundwater in the monitor wells. The seepage plume has reached alluvial groundwater at monitor well TDOH-12U. The pH of the seepage plume ranges from 6.2 to 7.5 and is somewhat more acidic than the alluvial groundwater (pH = 7.0 to 8.3). TDS is elevated in the seepage plume with values in the range of 500 to 1,000 mg/l. The alluvial groundwater has a TDS generally less than 400 mg/l. Chloride also is elevated in the seepage plume and ranges from around 200 to 400 mg/l, while chloride in the alluvial aquifer is below 100 mg/l. Sulfate is not elevated in the seepage plume and metals also are not elevated. WAD cyanide ranges from 0.01 to 0.15 mg/l, staying within the Nevada water quality standard of 0.2 mg/l. Thus the main constituents of concern are TDS and chloride. Although the seepage plume has reached alluvial groundwater at monitor well TDOH-12U, the water quality in that well is still within Nevada drinking water standards.

GMMC, in cooperation with the NDEP, has undertaken mitigation measures to stop the seepage from the north end of the tailings impoundment. The current seepage rate is about 34 gpm. Leakage




Source: WMC, 1994

Marigold Mine

Map 3-3

Location of Tailings, Wells, and Dam Piezometers

initially observed in 1991 was estimated at 190 gpm. In 1992, monitoring indicated that the rate was 110 gpm. ***GMMC*** has installed dikes within the tailings to isolate the northern end of the tailings and has stopped using the northern part of the tailings to facilitate drainage of that section of the tailings. Although the seepage plume is expected to migrate northward through the vadose zone and continue to impact alluvial groundwater, the mitigation measures undertaken by ***GMMC*** are expected to reduce the amount of the seepage entering alluvial groundwater and prevent the seepage from elevating groundwater above state water quality standards. All seepage and the potentially impacted groundwater is within ***GMMC*** site boundaries and the alluvial groundwater is not used for domestic consumption.

**Lone Tree Mine Dewatering and Water Level Declines at the Marigold Mine**

Water levels in the Marigold production wells and the monitoring wells to the north of the tailings impoundment have been declining since about 1992. Over the past 5 years (1994-1999), water levels at Marigold have dropped an estimated 35.0 to 37.5 feet. In 1994, WMC (1994) completed a study of the water level declines from 1992 through 1994. This study was based on actual water level changes in the production water wells and the tailings monitor wells at the Marigold Mine. The study concluded that dewatering at the Lone Tree Mine was the cause of the water level declines. The study showed that water levels had been dropping at a rate of about 7.0 to 7.5 feet/year in the Marigold production wells (WW wells) and the tailings impoundment monitor wells (TDOH wells). The study concluded that when the Lone Tree Mine increased its dewatering rate, the rate of decline also would increase. The Marigold Mine pumps 425 gpm from its 3 production wells and has maintained that pumping rate for the past 5 years.

This study contradicts a groundwater model prepared by HCI (1994) for the Lone Tree Mine. The HCI model indicated that the 10-foot drawdown contour associated with pit dewatering at the Lone Tree Mine would not reach the Marigold Mine until the year 2036. According to the HCI model, no impacts to the Marigold Mine from Lone Tree Mine dewatering should currently be occurring. HCI's 1994 modeling effort was based on the best available data at the time. Since that time, additional monitoring data, which include information from the Marigold Mine, have been collected and are currently being incorporated into a revised groundwater model (HCI 2000).

Table 3-5 identifies monitor wells in the Marigold Mine area. Those with established water level decline rates indicate that the water levels in the mine area have been dropping at an average rate of 7.4 feet per year since 1993. The Lone Tree Mine began dewatering in 1991 and has been increasing its dewatering rate in steps as the pit deepens. The average dewatering rate for the Lone Tree Mine in 1999 was 36,000 gpm, up from 23,000 gpm in 1994. To reconstruct the pre-mining water table in the Marigold area, the water level decline rate in each monitor well has been used to estimate the water level in 1991. This presents a conservative estimate of the maximum pre-mining water level because the effect of Lone Tree dewatering on the Marigold area probably did not begin until around 1994 (WMC 1994). It is evident from Table 3-4 that water levels have declined about 35 to 40 feet since 1991-1993. It can be expected that when the Lone Tree Mine ceases operations around the year 2006, the water table in the Marigold Mine area will rebound. A conservative estimate would have the water table in the Marigold Mine area rebounding to pre-1992 water levels in about 30 years following cessation of dewatering at the Lone Tree Mine. Map 3-4 shows estimated post-mining water level contours at the Marigold Mine.

### 3.1.2 Environmental Consequences

The primary water resources issues for the proposed project include: 1) the generation of additional waste rock dumps; 2) expansion of the existing tailings impoundment and construction of a new tailings impoundment; 3) expansion of existing heap leach

facilities and construction of a new heap leach pad; 4) the expansion of existing open pits and the development of two pits (i.e., 8-North and 5-North); and 5) additional surface water diversions. In addition, the existing tailings impoundment is currently seeping tailings fluid to groundwater at a rate of about 34 gpm; expansion of this facility would require additional efforts to minimize seepage and protect groundwater.

#### 3.1.2.1 Proposed Action

Geochemistry

***Existing waste rock at the Marigold Mine does not appear to be acid generating (see Section 3.1.1.1). The proposed pits and pit expansions would include the same lithologic units that are currently being mined with the exception of the proposed 5-North and 8-North pits. These proposed pit areas would include the Havallah Formation and Edna Mountain Formation rocks in addition to the other lithologic units common at the mine site. The Havallah and Edna Mountain rock samples had NNP values below the BLM guideline of 20 T/kT. However, the low pyritic sulfur content of these samples and the paste pH values above 7.0 suggest that the rocks would not generate acid (Appendix B, Tables B-4 and B-5).***

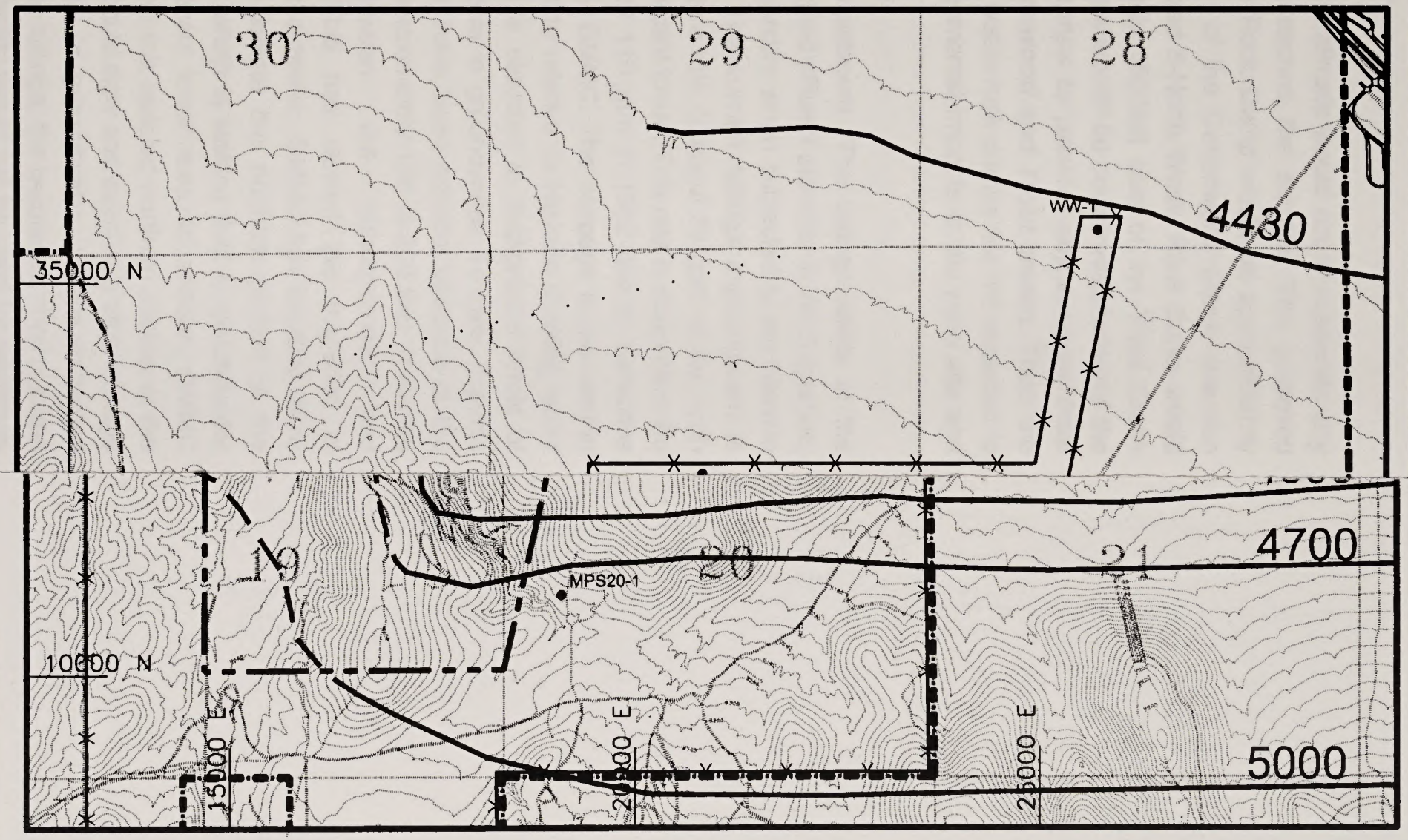
***If rocks with high pyrite content are encountered during mining of either of the proposed new pits, GMMC would encapsulate the pyritic rock in the waste rock dumps or blend the pyritic rock with oxide waste rock to prevent the generation of acidic seepage from the waste rock dumps. These preventative measures are described in detail in the approved Sulfide Waste Management Plan.***

Nevada MWMP tests conducted on existing waste rock from all the pits, the tailings solids, and the leach solids have shown that effluent from the waste material is consistently elevated in arsenic, mercury, and molybdenum. Waste rock from the East Hill Pit also could be elevated in TDS, chloride, and sulfate. Based on this information, water infiltrating waste rock dumps has the potential to generate seepage from the base of the dumps that may be elevated in arsenic, mercury, and molybdenum relative to Nevada drinking water and stock water standards. Nevada aquatic life water standards also could be exceeded occasionally. ***Waste rock from the proposed 8-North Pit would not be expected to be acid-generating or generate an effluent elevated in metals. Column leach tests on Edna Formation and Havallah Formation rocks (Appendix B, Table B-7) have shown no potential for acid generation or metal exceedences. These are the two main rock types present in the 8-North Pit area. Waste rock from the 5-North Pit area may have the potential for generating an effluent elevated in arsenic and mercury because it contains a considerable amount of Valmy Formation rock.*** Methods to reduce or mitigate the infiltration of water into the waste rock dumps, tailings, and leach heaps are discussed in the following sections. In addition, reclamation of the waste rock dumps, tailings, and leach heaps would be conducted in accordance with the *Nevada Guidelines for Successful Revegetation for the Nevada Division of Environmental Protection, BLM, and USFS*. Use of these methods should reduce or eliminate any potential geochemical effects to surface and groundwater.

**Waste Rock Seepage**. The existing 8-South Waste Rock Dump has been reclaimed with 6 inches of run-of-mine material and revegetated using native/introduced plant species seed mix. The proposed new waste rock dumps would be reclaimed in a similar manner. Infiltration of water into the waste rock dumps would be minimal because of the soil amendment cover and the arid climate of northern Nevada. If seepage should occur, it would be minimal and limited to the mine site. Seepage would not be expected to reach groundwater because of the depth of groundwater below the alluvial cover at the mine site and the presence of a clay layer in the alluvium about 80 feet below the surface that would inhibit downward seepage of effluent from the waste rock pile. Seepage would not be expected to reach surface water diversions because the seepage rate would be

LEGEND

- Private Land/Public Land Claim Boundary
- Current Permit Boundary
- Proposed Permit Boundary
- Water Level Surface (Feet)
- Estimated Water Level Surface (Feet)
- Well or Boring




Marigold Mine

Map 3-4

Post-Mining

Groundwater Levels

facilities and construction of a new heap leach pad; 4) the expansion of existing open pits and the development of two pits (i.e., 8-North and 5-North); and 5) additional surface water diversions. In addition, the existing tailings impoundment is currently seeping tailings fluid to groundwater at a rate of about 34 gpm; expansion of this facility would require additional efforts to minimize seepage and protect groundwater.

#### 3.1.2.1 Proposed Action

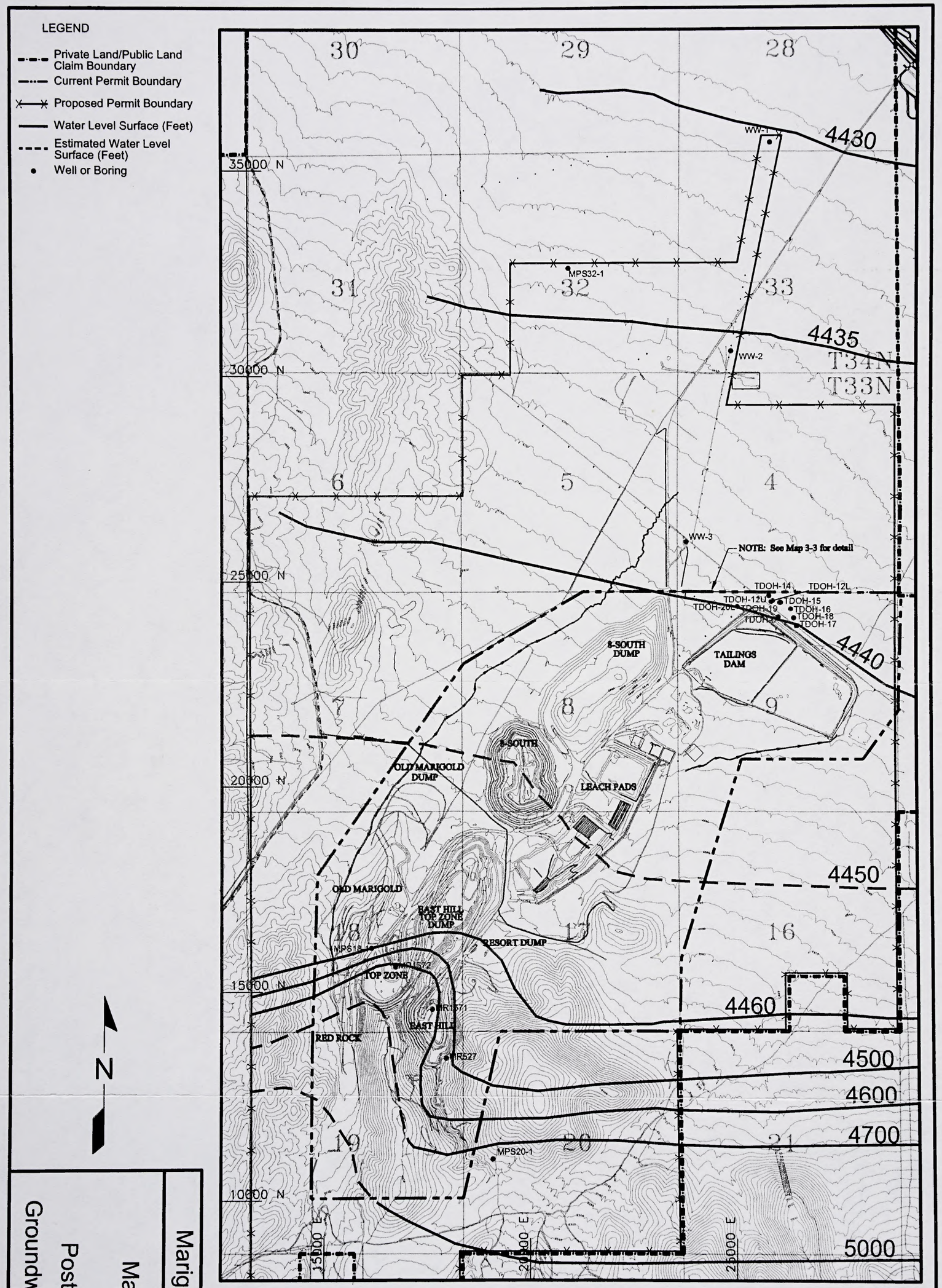
Geochemistry

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***If rocks with high pyrite content are encountered during mining of either of the proposed new pits, GMMC would encapsulate the pyritic rock in the waste rock dumps or blend the pyritic rock with oxide waste rock to prevent the generation of acidic seepage from the waste rock dumps. These preventative measures are described in detail in the approved Sulfide Waste Management Plan.***

Nevada MWMP tests conducted on existing waste rock from all the pits, the tailings solids, and the leach solids have shown that effluent from the waste material is consistently elevated in arsenic, mercury, and molybdenum. Waste rock from the East Hill Pit also could be elevated in TDS, chloride, and sulfate. Based on this information, water infiltrating waste rock dumps has the potential to generate seepage from the base of the dumps that may be elevated in arsenic, mercury, and molybdenum relative to Nevada drinking water and stock water standards. Nevada aquatic life water standards also could be exceeded occasionally. ***Waste rock from the proposed 8-North Pit would not be expected to be acid-generating or generate an effluent elevated in metals. Column leach tests on Edna Formation and Havallah Formation rocks (Appendix B, Table B-7) have shown no potential for acid generation or metal exceedences. These are the two main rock types present in the 8-North Pit area. Waste rock from the 5-North Pit area may have the potential for generating an effluent elevated in arsenic and mercury because it contains a considerable amount of Valmy Formation rock.*** Methods to reduce or mitigate the infiltration of water into the waste rock dumps, tailings, and leach heaps are discussed in the following sections. In addition, reclamation of the waste rock dumps, tailings, and leach heaps would be conducted in accordance with the *Nevada Guidelines for Successful Revegetation for the Nevada Division of Environmental Protection, BLM, and USFS*. Use of these methods should reduce or eliminate any potential geochemical effects to surface and groundwater.

**Waste Rock Seepage**. The existing 8-South Waste Rock Dump has been reclaimed with 6 inches of run-of-mine material and revegetated using native/introduced plant species seed mix. The proposed new waste rock dumps would be reclaimed in a similar manner. Infiltration of water into the waste rock dumps would be minimal because of the soil amendment cover and the arid climate of northern Nevada. If seepage should occur, it would be minimal and limited to the mine site. Seepage would not be expected to reach groundwater because of the depth of groundwater below the alluvial cover at the mine site and the presence of a clay layer in the alluvium about 80 feet below the surface that would inhibit downward seepage of effluent from the waste rock pile. Seepage would not be expected to reach surface water diversions because the seepage rate would be




Marigold Mine

Map 3-4

Post-Mining Groundwater Levels



low and the arid climate would act to evaporate any seepage that reaches the surface. The proposed 5-North Waste Rock Dump would be approximately 1,000 feet east of the Cottonwood Creek diversion and the proposed 8-North Waste Rock Dump would be approximately 150 feet east of the Trout Creek diversion. ***Berms would be constructed around the waste rock dumps to prevent any seepage from entering Cottonwood and Trout creeks.*** Thus, the proposed new waste rock dumps are not expected to result in environmental impacts to the mine site and vicinity.

**Tailings Impoundment**. The tailings solids at the Marigold Mine yield effluent elevated in WAD cyanide, arsenic, and mercury when subjected to the Nevada MWMP tests. The current tailings impoundment is leaking water at a rate of about 34 gpm at the north end near the decant tower. This rate is down from the seepage rate of 110 gpm in 1992 due to corrective action taken by GMMC. The seepage is elevated in TDS and chloride relative to Nevada drinking water standards and is elevated in background levels of these constituents in groundwater. To date, impacts to groundwater have been minimal because of the presence of approximately 150 to 200 feet of alluvial sediment between the impoundment and groundwater. This has slowed the migration of seepage to groundwater. GMMC has installed dikes and berms to isolate the northern portion of the tailings facility, which is leaking fluid to groundwater through the decant tower area. In addition, GMMC plans to dewater this isolated northern section of the tailings. This should slow and eventually stop leakage of tailings fluid to groundwater. In the proposed expansion of the tailings, the isolated northern section of the tailings facility would not be used for additional tailings.

The proposed new tailings impoundment would handle tailings after the existing facility is filled to the permitted capacity. The new impoundment would be lined with a seepage capture system and seepage to groundwater is not expected to occur. The tailings impoundment would be drained and reclaimed with growth media at the end of mining.

**Heap Leach Facility**. The existing leach solids at the Marigold Mine have the potential to produce effluent elevated in arsenic and mercury when subjected to the Nevada MWMP tests. Leach solids provided by the proposed expansion would come from sources similar to those currently producing leach solids. Constituent levels in these solids are expected to be similar to those identified in the existing leach solids. Existing leach pads at the mine are lined with a seepage detection and capture system. The proposed new leach pad would have a similar liner system, as required by the State of Nevada, with the capacity to contain all process fluids and meteoric waters generated by 25-year, 24-hour storm events. Thus, seepage from the expansion of existing leach pads and the proposed new leach pad is not expected.

These pads would be drained, rinsed, and reclaimed according to Nevada regulations governing cyanide leach pads at the end of mining. This reclamation would involve heap rinsing, heap grading, the addition of growth media, and revegetation of the drained and rinsed pads. The rinse solutions would be diverted to ponds, and these ponds along with the process ponds would be reclaimed as required by Nevada Administrative Code 445.24386 and Code 445.14338. A permanent closure plan for the heap leach facility would be submitted to NDEP 2 years prior to closure. Long-term management of the heap leach draindown has not been analyzed and would require separate permit approval prior to closure.

The leach pads may be reclaimed using an alternative method that involves treatment of the leach pad with a proprietary mixture of chemicals and nutrients to enhance bacterial growth and precipitation of potentially adverse constituents. This method, known as the Greenworld method, is currently being evaluated at the Glamis Dee Gold Mine in Eureka County, Nevada.

***Using this methodology, cyanide, nitrate/nitrites, and metal constituents can be altered or immobilized in the heap. After chemical treatment, the slopes would be reduced and a 6-inch***

***evapotranspiration cover composed of soil would be applied. The associated leach ponds would be closed and reclaimed. This treatment, combined with the soil cover, would ensure that drinking water standards would be met for all constituents except salts and total dissolved solids. If land application of heap rinseate is required, measures would be taken to protect waters of the state and no contamination of the groundwater would occur. The specific measures to be taken would be based on rinse tests and would be included in the final closure plan. Actions described in the final closure plan that have not been addressed in the Final EIS, would be subject to additional NEPA analysis.***

**Surface Water**

The primary issues related to surface water resources include the potential for degradation of the quality of waters of the State of Nevada; accelerated erosion, sedimentation, and resulting channel or watershed instability; reduction in flows as a result of groundwater pumping or drainage modification; impacts to riparian areas or wetlands; and impacts to water rights.

Best management practices and available control technologies would be specified and reviewed for the proposed project components as their design proceeds. At minimum, best management practices would include good housekeeping at the mill and storage facilities, preventative maintenance, periodic visual inspections of project components, material handling practices that minimize the exposure of pollutants to storm water, organized spill prevention and response procedures, sediment and erosion controls, and storm water controls. Each of these practices would be adapted to the facilities, processes, and personnel on the project area and carried out under a managed program of pollution prevention in accordance with state regulations and permits. Available control technologies include such features as double-lined process ponds, lined ditches and process facilities, containment walls or berms at the mill and at other process or storage facilities, leak detection systems water monitoring programs, and process facilities (including ponds, ditches and impoundments) designed to retain or withstand severe storm runoff events. These practices would prevent or minimize degradation of surface water resources.

Further detail regarding storm water management and erosion control, spill containment provisions, and component design features to control seepage and drainage for the existing site features are presented in the permit documents described in Section 2.2.2.2. These are on file and can be referenced at the Marigold Mine and the respective state and federal agency offices. Similar documentation and preparation is required and would be completed for the proposed components.

Impacts to surface water quality are expected to be minimal, given the proposed process solution controls and erosion and sediment controls. Monitoring data along Trout Creek to date suggest that the project has had minimal effect on surface water quality, and impacts have occurred (increased iron and manganese) are related mostly to aesthetic standards as opposed to health-derived standards. The causes of the increases in these constituent concentrations in a downstream direction are not currently known. Water monitoring and reporting programs are ongoing for the project, as is compliance with permit stipulations for storm water control, spill control, and process fluid containment.

The POO/RP for the proposed mine expansion discusses erosion control for slopes and other disturbed areas, road drainage, diversions around pits and process components, collection pond storage capacities, tailings impoundment storm-event design, and process facility containment features that would prevent or minimize disturbed area runoff and mitigate related potential impacts to surface water resources.

Other potential impacts to surface water resources may occur as a result of groundwater pumping and the effects of stream diversions. Both Cottonwood

Creek and Trout Creek grade from intermittent toward ephemeral flow characteristics in the downstream direction as they traverse the project area and infiltrate into the deep fan alluvium toward the Humboldt River (see Map 3-1). Based on field studies, perennial reaches of these streams do not occur within the project area, but are restricted to the steeper reaches upstream on Battle Mountain. As discussed in the groundwater impact analysis portion of this chapter, mine dewatering is not anticipated to occur. Groundwater pumping is not expected to effect local surface water recharge sources or to create significant impacts to streamflows or spring flows.

The conceptual placement and design of stream diversions are described in Section 2.2.2 under Surface Water Diversions. The existing Trout Creek Diversion west of the Red Rock Pit (North and South) has previously been examined and approved in coordination with federal agencies including the COE (BLM 1997). The proposed modification to the existing Trout Creek diversion and the construction of the proposed Cottonwood Creek diversion would not be required for several years after initiation of the Proposed Action. During that time, the design and agency review process for these proposed features would be ongoing. Final design and associated mitigation measures would be subject to agency approval and permitting before the diversion activities occurred. Design of the diversions would follow standard engineering hydrologic and hydraulic design procedures and would be conducted under the supervision of a professional civil engineer registered in the state of Nevada. The channels would carry intermittent or ephemeral flows.

The conceptual design for the Cottonwood Creek diversion indicates that it would route flows around the proposed project components and return them to the stream channel at a point below the proposed disturbance. Given that standard design procedures and agency approval would be incorporated into the diversion design, and that Cottonwood Creek flows only occasionally along this reach, no impacts to surface water resources are anticipated.

Modification or construction of the diversions would disturb additional acreage of waters of the U.S. To date, no acreage of riparian or wetland habitat has been disturbed by existing diversion activities. Approximately 2.8 acres of waters of the U.S. have been previously disturbed by existing diversion construction. Site-specific field investigations have not been conducted to date for the additional areas under consideration, but data from the adjacent existing surveys and accompanying maps and aerial photos indicate that an additional area of approximately 1.3 acres of waters of the U.S. would be disturbed by proposed project activities. Adding this to the previous 2.8 acres disturbed, the total disturbed area of waters of the U.S. would be approximately 4.1 acres. Prior to any disturbance in these areas, particularly Cottonwood Creek, detailed on-site studies would be completed and appropriate plans and permits would be approved.

***Site-specific investigations would be made prior to construction activities to determine the actual acreage of waters of the U.S. that would be disturbed by project activities. Design of project components has not been finalized, and completion of field delineations and disturbed acreage assessments are a part of ongoing project activities. If, after completion of these studies and coordination with the U.S. Army Corps of Engineers, it is determined that an individual permit is required, additional studies and permitting activities would be undertaken to satisfy the objectives and content requirements of the individual permit.***

Potential impacts to surface water rights in or near the project area are not anticipated as a result of mine construction and operation.

**Groundwater**

Groundwater impacts due to the Proposed Action would include: 1) the continued removal of groundwater for production water uses at a maximum rate of 475 gpm and 2) potential seepage from waste rock dumps.

**Groundwater Withdrawal**. ***The Lone Tree Mine is currently supplying water for operations use at the Marigold Mine***. The continued pumping of a maximum of 475 gpm of groundwater for production water uses would not be expected to produce any adverse impacts to groundwater flow or flow in nearby springs and seeps. The current production water wells draw water from both the alluvium and the bedrock and have had minimal impact on nearby groundwater resources. Therefore, no impacts to groundwater rights are anticipated.

**Waste Rock Seepage**. As discussed in Section 3.1.2.1, Geochemistry, no seepage from waste rock dumps is expected to reach groundwater; therefore, no additional effects to groundwater from the Proposed Action is anticipated.

**Tailings**. Continued use of the existing tailings facility would not involve the northern part of the facility that is currently seeping effluent elevated in chloride and TDS to groundwater. Mitigation measures taken by GMMC have reduced the seepage rate from the northern portion and are expected to prevent degradation of groundwater quality.

### 3.1.2.2 8-South Partial Pit Backfill Alternative

**Geochemistry**

This alternative would involve placement of waste rock from the 8-North Pit to the 8-South Pit, eliminating the need for the 8-North Waste Rock Dump expansion. This would reduce the potential for seepage from an additional waste rock dump in the event of prolonged wet weather in northern Nevada. ***The 8-South Partial Pit backfill alternative would involve waste rock originating from the 8-North Pit, which includes Havallah and Edna formation rock types. Column leach test results on these rocks have shown that site groundwater flowing through these rocks would not generate acidic seepage and would not generate an effluent with metals or non-metals (i.e., sulfate) that exceed Nevada drinking water standards (Appendix B, Table B-7). Therefore, backfilling the 8-South Pit with waste rock from the 8-North Pit would eliminate the possibility of a pit lake and eliminate the development of the 8-North Waste Rock Dump.***

**Surface Water**

In general, the potential impacts for this alternative are the same as those described for the Proposed Action. However; without the need for the 8-North Waste Rock Dump expansion, the lower reach of the Trout Creek diversion would not need to be realigned. This would reduce the amount of additional disturbance of the existing Trout Creek diversion.

**Groundwater**

***No impacts are expected to groundwater quality from backfilling the 8-South Pit with Havallah Formation and Edna Formation rock originating from the 8-North Pit. As discussed above, these two lithologic types do not have the potential for acid generation, and based on column leach tests (Appendix B) would not be capable of leaching metals to groundwater that would flow through the backfilled 8-South Pit.***

### 3.1.2.3 No Action Alternative

**Geochemistry**

Under the No Action Alternative, the potential exists for the formation of a 10-foot deep seasonal pit lake in the 8-South Pit approximately 30 years after currently approved mining operations cease. Water in this lake could contain high levels of arsenic and mercury; however, the lake should be present only in the winter months.

Potential seepage from the waste rock dumps associated with mining of the 8-North and 5-North pits would not occur. The existing tailings impoundment would be expanded under the current permit and remediation of seepage from the existing tailings impoundment would continue. Closure of existing

leach pads would occur sooner than under the Proposed Action.

**Surface Water**

No additional diversions of Trout Creek and Cottonwood Creek would be required and disturbances to 1.3 acres of waters of the U.S. would not occur.

**Groundwater**

Removal of 475 gpm of groundwater used for milling operations would only continue through the currently permitted period approved for the existing operations. In addition, no rinseate water would be required beyond that needed for currently permitted leach pad operations.

### 3.1.3 Cumulative Impacts

Mining is the main industry in the Winnemucca area of northern Nevada. As discussed under Section 3.2 (Geology and Minerals), there are many gold mines currently operating or planned for the area between Winnemucca and Battle Mountain, Nevada. This area includes the Marigold Mine. The cumulative impact of all these open-pit gold mines is a substantial withdrawal of groundwater during mining to dewater the pits and then formation of pit lakes when the mines have ceased. The Marigold Mine would not contribute substantially to this cumulative water withdrawal since its total groundwater withdrawal rate would be minimal. Most of the pits would be dry.

The combined acreage of disturbance from the Proposed Action and other existing mining activities within or immediately adjacent to the Trout Creek and Cottonwood Creek watersheds is on the order of 2,700 acres (4.2 square miles). The combined Trout Creek and Cottonwood Creek watershed area is approximately 31 square miles. The disturbance within or immediately adjacent to the watersheds represents approximately 13 percent of their combined areas, a significant proportion. Other nearby mining projects, such as the Lone Tree Mine, Battle Mountain Gold Company's operations, and the Mule Canyon project, disturb additional lands and water resources in the vicinity. Of these, only the Lone Tree Mine discharges water to the Humboldt River (via Herrin Slough). With this exception, the proposed project and the other projects mentioned would have little effect on the Humboldt River due to their hydrologic setting (water occurrence or management approaches that do not create a direct hydraulic connection to the river), distance from the river, or because they do not require substantial mine dewatering and discharge.

A substantial amount of land disturbance has occurred in the Trout Creek and Cottonwood Creek watersheds as a result of exploration and mining activities. Several open-pit areas will essentially be withdrawn from contributing to surface runoff and streamflows. This is more significant in mountainous headwater areas upstream of the proposed project, where the majority of streamflow is generated and occurs. Most of the runoff generated on the project area is absorbed by porous alluvial deposits. Sub-basin streamflows, evapotranspiration and groundwater recharge are not likely to be significantly affected by the additional downgradient Marigold Mine disturbance. However, the amount of disturbance in these watersheds is a concern, and compliance with permitting requirements is essential in order to minimize flow and water quality impacts (including erosion and sedimentation).

The total acreage of waters of the U.S. within the cumulative impact area is not known; however, extensive stream channel networks are present in the area. It is likely that the disturbance to waters of the U.S. in the cumulative impact area is a small percentage (less than 10 percent) of the overall acreage. This would not significantly increase with the limited additional disturbance from the proposed project or alternatives. Additional surface water quality impacts would be insignificant, since the affected water quality parameters (based on current monitoring) are related to aesthetic standards, and almost all of the surface water from the upgradient watershed seeps into the alluvial fan system.

### 3.1.4 Potential Mitigation and Monitoring

*Issue: Potential migration of waste rock dump seepage to adjacent creeks and drainages and degradation of water quality.*

*Measure 1: Monitoring of existing and proposed waste rock dumps would be conducted during the operational life of the project, as required by General Storm Water Permit #GNV 300000, to ascertain the amount of surface-exposed seepage (if any) from the waste rock. Small berms would be constructed downgradient of the proposed waste rock dumps. Shallow depressions along the berm would collect seepage during periods of prolonged precipitation events. Any seepage collected in these depressions would evaporate in a short period of time. The shallow depressions would be regularly inspected during the life of the project, and any water collecting in the depressions would be sampled for analyses in coordination with the BLM and the Nevada Division of Environmental Protection (NDEP).*
*Effectiveness: Construction of berms would prevent the migration of seepage to adjacent creeks or drainages and, as a result, prevent the degradation of water quality associated with these watercourses. The regular inspection of the waste rock dumps and depressions along the berms would determine whether seepage has occurred. Water quality analysis completed for seepage collected in these depressions would be compared to State water quality standards. If State water quality standards are exceeded, additional mitigation measures would be developed to prevent detrimental effects to wildlife from the ingestion of contaminated water.*

*Application: This measure would apply to the Proposed Action and 8-South Partial Pit Backfill Alternative.*

*Issue: Potential formation of a pit lake in the existing 8-South Pit.*

*Measure 2: In the event the 8-North Pit is not mined, the 8-South Pit would be backfilled with Edna and Havallah formation rocks to an elevation of 4,460 feet. This level of backfilling would provide 10 feet of freeboard above an expected pit lake that could form within 30 years after the cessation of mining. The Havallah and Edna rocks that would be used for pit backfill would primarily originate from existing waste rock material within the 8-South Pit. Any additional Edna and Havallah formation waste rock material needed from outside of the 8-South Pit would be tested via Static ABA and MWMP tests before being placed in the 8-South Pit. Only waste rock material that is not acid-generating and not capable of leaching metals and non-metals in exceedence of Nevada drinking water standards would be used for pit backfill.*

*Effectiveness: Pit backfilling would eliminate the formation of a pit lake in the existing 8-South Pit.*

*Application: This measure would apply to the 8-South Partial Pit Backfill Alternative.*
*Issue: Potential contamination of groundwater as a result of the infiltration of meteoric water (i.e., rainwater, snowmelt) with elevated levels of metals through the 5-North and 8-North pit bottoms.*

*Measure 3: If the 5-North and 8-North pits are developed, wells would be installed downgradient (i.e., north) of each pit to monitor groundwater quality during mining and mine closure. These monitoring wells would be installed within 200 feet of each pit and monitored on a quarterly basis, with the results being sent to the NDEP and BLM for review. Following mine closure, these monitoring wells would continue to be monitored by GMMC as required for BLM and NDEP.*

*Effectiveness: Groundwater quality data obtained from the monitoring program would be evaluated by the BLM and NDEP on a regular basis to determine if groundwater quality had been affected by the infiltration of contaminants*

***through the pit bottoms. If groundwater quality is degraded beyond standards established by the BLM or NDEP, additional mitigation measures would be developed to avoid future contamination.***

***Application: This measure would apply to the Proposed Action and 8-South Partial Pit Backfill Alternative.***

### 3.1.5 Residual Adverse Impacts

No residual adverse impacts are expected from the Proposed Action. Seepage from waste rock dumps is not expected to reach groundwater and the tailings and heap leach facilities would be reclaimed to prevent seepage into the post-closure period. Water levels return to near pre-mining levels following mine closure.

# 3.2 Geology and Minerals

## 3.2.1 Affected Environment

The Marigold Mine is located in the Battle Mountain Mining District of north-central Nevada, approximately 40 miles east of Winnemucca and about 3.0 miles south of Valmy in Humboldt County, Nevada (Map 3-5). The mine has been operating since 1988 and consists of four open pits developed on siliceous gold ore along faults and fault intersections in the Valmy Formation and the Antler/Battle Sequence. The mineralization is epithermal in nature and the oxidized gold ore zones are mined and heap-leached for recovery of the gold. Milling is used on certain high-grade ore ***and low-grade is processed by heap*** leaching. Sulfide ore is currently not mined.

### 3.2.1.1 Regional Geological Setting

The Marigold Mine is located on the northwestern flank of the Battle Mountain Range. The Battle Mountain Range is part of the Basin and Range physiographic province of northern Nevada. The Marigold Mine lies within the drainage of the Humboldt River. This part of northern Nevada is characterized by large block uplifts separated by deep structural valleys that contain alluvial gravels and sands as well as old Pleistocene lake beds. These alluvial valleys can be up to 10,000 feet deep. North of the Marigold Mine, the valley alluvium is at least 2,000 feet deep. Bedrock in the uplifted blocks is commonly highly deformed Paleozoic quartzites, shales, cherts, and limestones. The Marigold Mine encompasses an area of deformed Paleozoic rocks transected by north-trending faults. Mineralization at the mine is surrounded by and frequently covered by alluvial fan sediments shed from the Battle Mountain Range.

The Battle Mountain Mining District has been an active area of exploration and mining since 1866. Principal commodities mined have been copper, gold, silver, lead and zinc. Mining prior to about 1980 has been concentrated on the south and east sides of Battle Mountain in Copper Canyon, Copper Basin, Galena Canyon, and Cottonwood Canyon (Map 3-5). Current mining on the east side of Battle Mountain is mainly in the area of the old Copper King Mine. Mining on the south side of Battle Mountain has been in the Copper Canyon area associated with the proposed Phoenix Project (Map 3-5). The Marigold Mine has been the principal mine on the north side of Battle Mountain since 1988. Recent gold discoveries in the district include the North Peak, Trenton, and Valmy deposits (BLM 1998). Along the west side of Battle Mountain, the Buffalo Valley gold mine has operated intermittently over the past 10 years. The Lone Tree gold deposit is located about 8 miles northwest of the Marigold Mine and has been in operation since 1990 (BLM 1995).

The ore deposits of the Battle Mountain district are hosted in Paleozoic quartzites, argillites, cherts, and limestones that have been folded and faulted during four major orogenic episodes. The Antler Orogeny of late Mississippian to early Pennsylvanian age is the major structural event responsible for deformation of most of the ore-bearing lithologic units in the mining district (Table 3-7). This was followed by a late Permian orogeny that affected areas to the west of Battle Mountain. This orogenic episode is preserved only in the Upper Plate rocks of the Battle Mountain area. During the Mesozoic, continued deformation to the west of Battle Mountain resulted in the Sonoma Orogeny and the Golconda Thrust, which brought rocks from western Nevada (Upper Plate rocks) eastward over the Lower Plate rocks already deformed by the Antler Orogeny. The Golconda Thrust is a major structural feature in the ore deposits of the Marigold Mine. During the Tertiary, Basin and Range faulting and uplift resulted in the formation of Battle Mountain. It was during this period of faulting, volcanism, and geothermal activity that the gold deposits of the Battle Mountain district were formed.

### 3.2.1.2 Stratigraphy

The stratigraphy of the Battle Mountain area is shown in Table 3-7. The general geology of the district and

surrounding areas is presented in Map 3-6. The Paleozoic stratigraphy of the project area can be divided into those units beneath the Golconda Thrust (Lower Plate rocks) and those units above the thrust (Upper Plate rocks).

**Lower Plate Sequence**

These units are Paleozoic quartzites, sandstones, cherts, argillites, limestones, and greenstones deformed by the Antler Orogeny. Principal units include the following (Roberts 1951):

- Comus Formation: Ordovician – chert and argillite
- Valmy Formation: Ordovician – quartzite, chert, argillite (ore bearing)
- Scott Canyon Formation: Mississippian – chert, argillite, limestone
- Harmony Formation: Mississippian – sandstone
- Battle Formation: Pennsylvanian – red-brown conglomerate (ore bearing)
- Antler Peak Formation: Pennsylvanian – limestone (ore bearing)
- Edna Mountain Formation: Permian – sandstone and conglomerate

These rocks were deformed by the Antler Orogeny and are complexly folded and sheared. The Battle Formation represents a period of clastic deposition after the Antler Orogeny was complete and before the onset of a less intense Permian orogeny. This is a major mapping unit in north-central Nevada. All Lower Plate units are highly deformed. The Valmy Formation is the principal host to gold mineralization at the Marigold Mine, the Trenton and Valmy deposits, and the Lone Tree Mine. In the area of the Marigold Mine, the Battle Formation and the Antler Peak Formation are grouped into a composite stratigraphic unit referred to locally as the Antler/Battle Sequence. This composite unit is mineralized in some of the pits at the mine.

**Upper Plate Sequence**

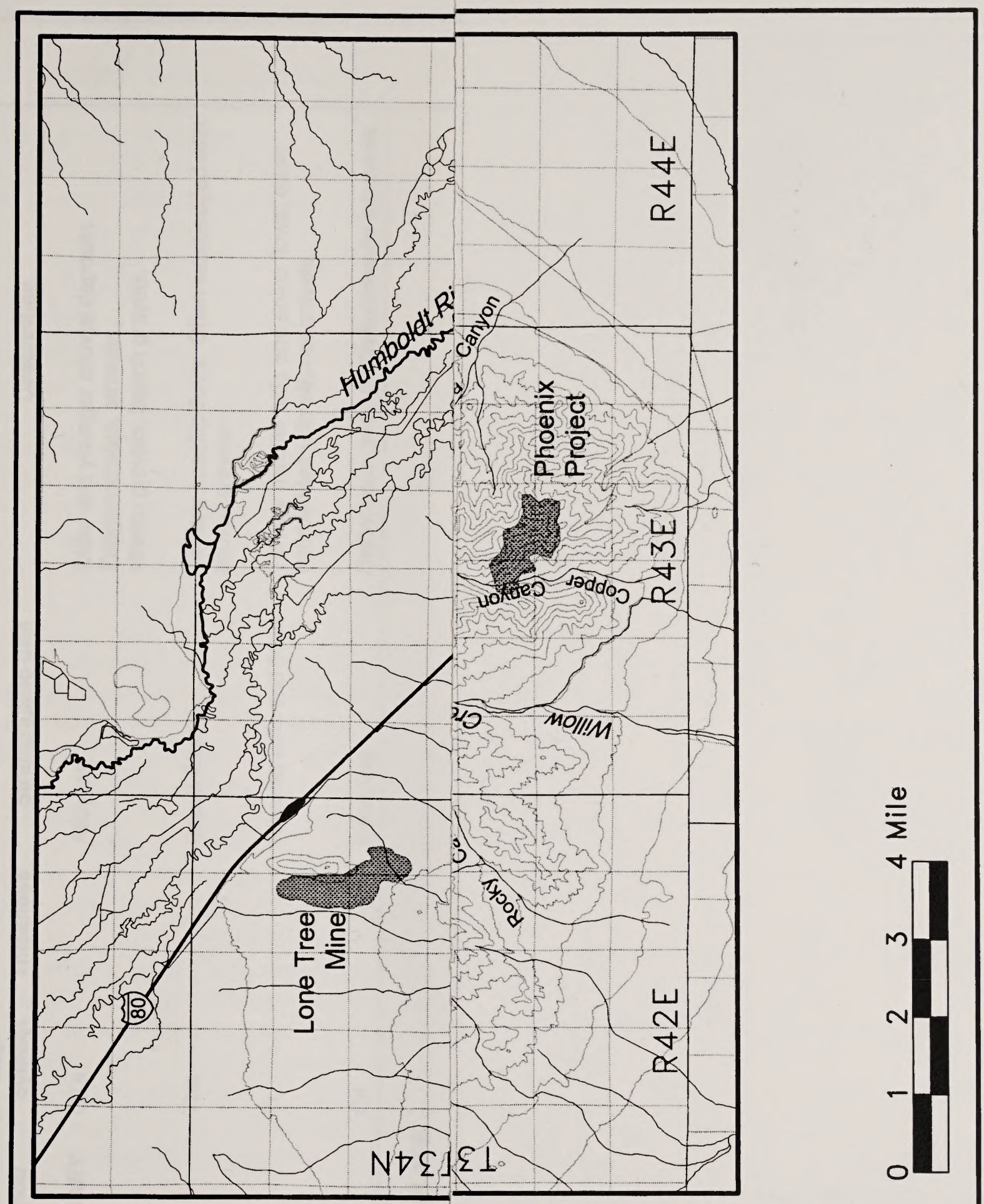
These units were thrust into place by the Golconda Thrust. These are Pennsylvanian units deposited in western Nevada in a basin separate from the one that contained the Paleozoic rocks of the Lower Plate Sequence. There are two principal stratigraphic units in the Upper Plate Sequence:

- Pumpernickel Formation: Pennsylvanian – quartzite, chert, argilllite
- Havallah Formation: Pennsylvanian – quartzite, chert, limestone

The Havallah Formation is a major stratigraphic unit in the Battle Mountain area and is the principal unit used to map the extent of the Golconda Thrust. The Pumpernickel Formation is often included with the Havallah Formation and not mapped separately, especially in maps published after 1990.

In the Late Cretaceous to early Tertiary periods (60 to 100 million years ago), many areas of western and central Nevada experienced the intrusion of plutons of granodiorite to quartz monzonite composition. These granitic magmas deformed the Paleozoic rocks and produced both alteration and mineralization of the rocks. Principal mineral deposits of this period of intrusive activity may have included the copper sulfide deposits found on the south side of Battle Mountain in the Copper Canyon area. Separating early Tertiary mineralization from the later middle Tertiary mineralization (30 to 45 million years ago) is often not possible because of the spatial overlap (both periods of mineralization along the same fault zone) and the resetting of isotopic clocks by the later mineralization.

During the Tertiary period, the Basin and Range underwent extensive faulting and volcanism. Rhyolite tuffs and basalt flows became interbedded with the alluvial fanglomerates that were developing as mountain ranges rose. Battle Mountain was formed during the middle to late Tertiary uplift (10 to




Marigold Mine

Map 3-5

General Location Map
with Mines

surrounding areas is presented in Map 3-6. The Paleozoic stratigraphy of the project area can be divided into those units beneath the Golconda Thrust (Lower Plate rocks) and those units above the thrust (Upper Plate rocks).

**Lower Plate Sequence**

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- Valmy Formation: Ordovician – quartzite, chert, argillite (ore bearing)
- Scott Canyon Formation: Mississippian – chert, argillite, limestone
- Harmony Formation: Mississippian – sandstone
- Battle Formation: Pennsylvanian – red-brown conglomerate (ore bearing)
- Antler Peak Formation: Pennsylvanian – limestone (ore bearing)
- Edna Mountain Formation: Permian – sandstone and conglomerate

These rocks were deformed by the Antler Orogeny and are complexly folded and sheared. The Battle Formation represents a period of clastic deposition after the Antler Orogeny was complete and before the onset of a less intense Permian orogeny. This is a major mapping unit in north-central Nevada. All Lower Plate units are highly deformed. The Valmy Formation is the principal host to gold mineralization at the Marigold Mine, the Trenton and Valmy deposits, and the Lone Tree Mine. In the area of the Marigold Mine, the Battle Formation and the Antler Peak Formation are grouped into a composite stratigraphic unit referred to locally as the Antler/Battle Sequence. This composite unit is mineralized in some of the pits at the mine.

**Upper Plate Sequence**

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Humboldt River

Elder Creek

Cottonwood Creek

Trout Creek

Marigold Mine

North Peak

Trenton Canyon Project

BATTLE MOUNTAIN

Antler Peak

Copper King Mine

Little Cottonwood Canyon

Galena Canyon

Phoenix Project

Copper Canyon

Willow Creek

Buffalo Valley Mine

Trenton Creek

Mill Creek

Timber Creek

Rocky Canyon

Lone Tree Mine

80

305

T34N

T33N

T32N

T31N

R43E

R42E

R44E

0 1 2 3 4 Mile

N

Marigold Mine

Map 3-5

General Location Map with Mines

**Table 3-7**
**Battle Mountain Area Stratigraphic Column**

| Geologic Time Period | Map Symbol | Thickness | Stratigraphic Unit | Description |
|---|---|---|---|---|
| **TERTIARY- QUATERNARY** | QTa | | Alluvium | Older and younger alluvial deposits. Fanglomerates, terraces, stream gravels, bench gravels. |
| | Tba | | Basalt flows | Tertiary basaltic flows. Often interbedded with alluvial gravels |
| | Tr | | Rhyolite tuffs and flows | Tertiary rhyolite tuffs and some flows, often interbedded with alluvial gravels. |
| **CRETACEOUS** | Cd | | Intrusives | Cretaceous granodiorite/monzonite intrusives. |
| **PALEOZOIC - UPPER PLATE** | | | | |
| Pennsylvanian | Ph | 10,500 feet | Havallah Formation | Interbedded quartzite, chert, argillite and limestone. Chert and quartzite most common lithologies. |
| | Cp | 5,000 feet | Pumpernickel Formation | Interbedded quartzite, chert, argillite and greenstone. Argillite and greenstone most common lithologies. |
| **PALEOZOIC - LOWER PLATE** | | | | |
| Permian | Pem | 100 feet | Edna Mountain | Grey calcareous sandstone and shale with interbedded chert-pebble conglomerate. |
| Pennsylvanian | Cap | 800 feet | Antler Peak Formation | Medium-dark gray bedded limestone /shaly limestone. |
| | Cb | 700 feet | Battle Formation (Antler/Battle Sequence) | Red-brown conglomerate with interbedded sandstone/shale. |

Table 3-7 (Continued)

| Geologic Time Period | Map Symbol | Thickness | Stratigraphic Unit | Description |
|---|---|---|---|---|
| Mississippian | Ch | 3,000 feet | Harmony Formation | Greenish-brown micaceous sandstone with interbedded shale and limestone. |
| | Csc[1] | 2,000 feet | Scott Canyon Formation | Chert, argillite, slate and limstone with interbedded greenstone. |
| Ordovician | Ov | 3,000 feet | Valmy Formation | Highly deformed with complex folding, Interbedded quartzite, chert, argillite, slate, and greenstone. |
| | Oc[1] | 2,000 feet | Comus Formation | Complex folding. Massive quartzites. Variegated cherts and slates. Greenstones show pillow lava structure. Interbedded chert, slate, and argillite. Variegated chert. |

[1]These units are small and do not appear on the regional geology map due to scale.

Source: Roberts 1964.

25 million years ago). Geothermal activity along the fault zones led to the emplacement of siliceous gold ores both along the faults and as replacements in the rock units adjacent to the faults. The gold deposits of the Battle Mountain area were formed during this time.

#### 3.2.1.3 Structure

The major structural features of the Battle Mountain area are shown on Map 3-6. The main structural features are: 1) thrust faults, and 2) north-trending normal faults. The thrust faults are the result of the Antler Orogeny, the Permian orogeny, and the emplacement of the Golconda Thrust (Sonoma Orogeny). The normal faults are related to Basin and Range faulting during the middle to late Tertiary (Roberts 1964).

There is a zone of structural weakness that runs from Copper Canyon on the south side of Battle Mountain through Antler Peak and down Cottonwood and Trout creeks through the Marigold Mine area. In the Marigold Mine, the Golconda Thrust occupies this zone of structural weakness and probably is responsible in part for its trend through this part of Battle Mountain. To the south, in the higher areas of Battle Mountain, the zone of structural weakness is characterized by the concentration of normal faults. This zone is host to many of the ore deposits in Battle Mountain. To the northwest of Battle Mountain and the Marigold Mine, a similar zone of structural weakness with the same north-northeasterly trend is found at the Lone Tree Mine. This is the Wayne Zone and it is the principal locus of gold mineralization at the Lone Tree and Stone House deposits.

#### 3.2.1.4 Mineralization

There are 6 principal types of mineral deposits in the Battle Mountain area: 1) copper-gold, 2) lead-zinc-silver, 3) gold-copper, 4) antimony, 5) manganese, and 6) siliceous gold replacements. The first 5 types of deposits were known prior to the 1980s and are discussed by Roberts (1951). The siliceous gold deposits were discovered during the 1980s and 1990s and are the principal deposits of interest today in the Battle Mountain area.

The copper-gold deposits are found in Copper Canyon and consist of veins and replacement deposits with pyrite, pyrrhotite, arsenopyrite, and chalcopyrite. These are associated with the Cretaceous-early Tertiary intrusives. The lead-zinc-silver deposits also are associated with the intrusives and are mainly veins with minor replacements. They have the same mineralogy as the copper-gold deposits but with abundant galena and sphalerite. Oxidation of these deposits produces secondary copper minerals, such as malachite and azurite. This led to the discovery of the deposits by Native Americans, who in turn led early prospectors to the Battle Mountain area after the Civil War (1866).

The gold-copper deposits are bedded replacement deposits in calcareous rocks and contain pyrite, pyrrhotite, and chalcopyrite with common skarn minerals such as garnet and amphibole. The Carissa and Copper King mines, located along the south and east sides of Battle Mountain respectively, are deposits of this type. Antimony and manganese deposits are relatively minor and limited to a few areas.

The siliceous gold deposits were formed during the Tertiary along major faults and are principally replacement deposits. The Marigold Mine, the North Peak, Trenton, and Valmy deposits (Trenton Canyon Project), the Buffalo Valley Mine, and the Lone Tree Mine (Lone Tree and Stone House deposits) are examples of this type of mineralization. Only the Marigold Mine and the Lone Tree Mine have been continuously active. The Buffalo Valley Mine has had intermittent activity and the North Peak, Trenton, and Valmy (Trenton Canyon Project) deposits ***are currently being mined***.

#### 3.2.1.5 Mining History

The most productive of the pre-1980 mines was the Copper Canyon mine (Wilden 1964). This mine opened in 1866 and by 1945 had produced nearly

400,000 tons of copper-gold ore from underground workings to the 500-foot level. Copper grades mined ranged from 1 to 4 percent with 0.1 oz/ton gold. Development continued after 1945 to the 700-foot level, where lead-zinc-silver ore was mined. The ore was located principally in the Battle Formation and lies between the major north-trending normal faults. Other mines in the Copper Canyon area that were productive included the Tomboy, the Independence, and the Nevada.

The Copper King mine in Copper Basin, on the east side of Battle Mountain, opened in the 1880s and has produced copper and gold from the Harmony Formation. The Carissa mine opened in 1937 and produced gold ore with grades ranging from 0.3 to 0.62 oz/ton gold. The gold is associated with copper carbonates.

Battle Mountain Gold's Fortitude deposit is located in Copper Canyon. The Phoenix Project expands the low-grade potential of the Copper Canyon deposits. The Buffalo Valley Mine produces oxide gold ore from the Havallah Formation along a range front fault that borders the western side of Battle Mountain. The ore is disseminated in altered and mineralized rock. The Lone Tree Mine lies along the Wayne zone and consists of siliceous gold veins and replacements in the Valmy Formation.

The Marigold Mine was discovered in 1985 and production began in 1988. The Marigold Mine produces oxide gold ore from siliceous gold replacements along fault/fracture zones within the Valmy Formation and the Antler/Battle Sequence near the Golconda Thrust. Currently, there are 4 open-pit operations on the property: 1) 8-South, 2) Top Zone, 3) East Hill, and 4) Red Rock. The mine encompasses about 18,800 acres of private and public land. During 1997, Marigold mined approximately 15 million tons of waste rock, 4.8 million tons of leach-grade ore, and 0.725 million tons of mill-grade ore from the 4 active open pits. Since startup in 1988, Marigold has produced 631,085 ounces of gold.

Except for the higher grade ore that requires milling before being sent to a leach pad, the ore mined in the 4 active pits at Marigold is oxide gold amenable to direct cyanide leaching. Current mining involves a total of 1.7 million tons of waste rock and ore per month; mining is conducted on 20- to 40-foot benches in the 4 operating open pits. All four pits are above the current water table. The existing tailings impoundment contains about 196,500 cubic feet of tailings and is unlined but contains a clay base. Current discharge of water to the tailings impoundment is about 470 gpm and is based on an average of 1,750 tons per day of ore delivered to the mill. All leach pads are lined in accordance with Nevada regulations governing leach pads used with cyanide heap leaching.

#### 3.2.1.6 Oil, Gas, and Geothermal Development

No known oil, gas, or geothermal development has been identified in this portion of the Humboldt Basin.

#### 3.2.1.7 Seismicity

The Marigold Mine is not located in an area of known seismicity and the mine facilities are not located along a major Basin and Range fault zone. The nearest zone of seismic activity is the Nevada Seismic Belt located about 10 to 15 miles to the west. This belt runs northeast through eastern Pershing County and encompasses the Humboldt River Valley in Pershing County as well as Buena Vista Valley and Grass Valley. The belt runs west of the Lone Tree Mine and up toward the Twin Creeks Mine (Map 3-7).

The largest recorded earthquake near the Marigold Mine was a Richter Magnitude 7.8 located about 25 miles southwest of the mine along the Nevada Seismic Belt (Map 3-8). Two post 1970 seismic events with a magnitude around 4.0 to 5.0 on the Richter Scale were recorded within 20 miles of the mine site to the northwest. A study by Siddharthan et. al (1993) discussed in the Twin Creeks Draft EIS

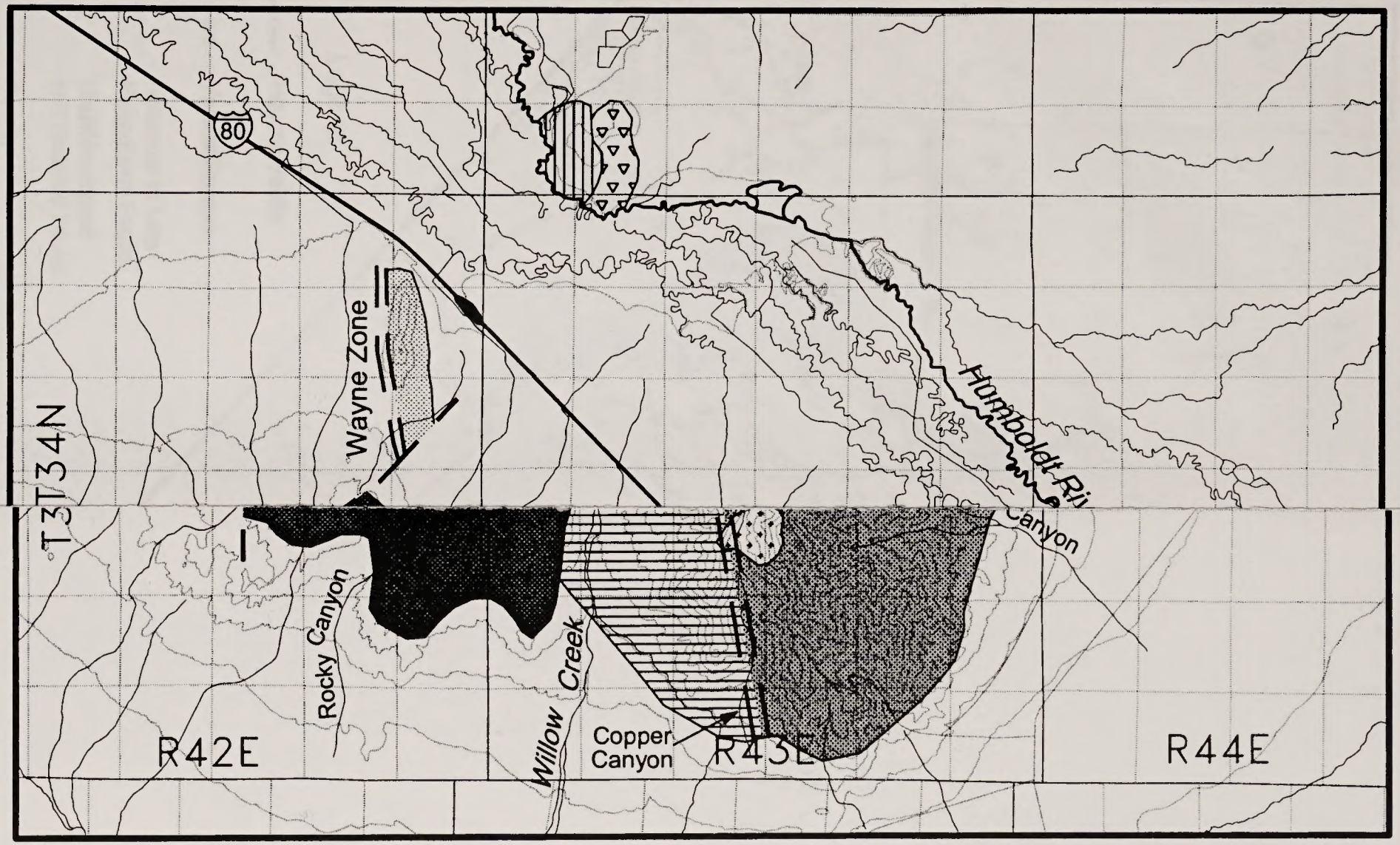
Legend

Quaternary/Tertiary Alluvium (QTa)

Tertiary basalt flows (Tba)

Tertiary rhyolite tuffs and flow (Tr)

Cretaceous intrusives (Cd)




0 1 2 3 4 Mile

Marigold Mine

Map 3-6

Regional Geologic Map

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Humboldt River

80

Valmy

Golconda Thrust

Trout Creek

Ovendida Fault

Creek

Ridge

North Peak

BATTLE MOUNTAIN

Antler Peak

Little Cottonwood Canyon

Galena Canyon

305

R44E

R43E

Copper Canyon

Willow Creek

Rocky Canyon

R42E

Wayne Zone

80

Cottonwood Creek

Trenton Creek

Mill Creek

Timber Creek

T34N

T33N

T32N

T31N

0 1 2 3 4 Mile

Legend

- Quaternary/Tertiary Alluvium (QTa)
- Tertiary basalt flows (Tba)
- Tertiary rhyolite tuffs and flow (Tr)
- Cretaceous intrusives (Cd)
- Permian Edna Mountain (Pem)
- Pennsylvanian Havallah Formation (Ph)
- Pennsylvanian Pumper-nickel Formation (Cp)
- Pennsylvanian Battle Formation (Cb)
- Mississippian Harmony Formation (Ch)
- Ordovician Valmy Formation (Ov)
- Contact
- Fault (Normal)
- Fault (Thrust)

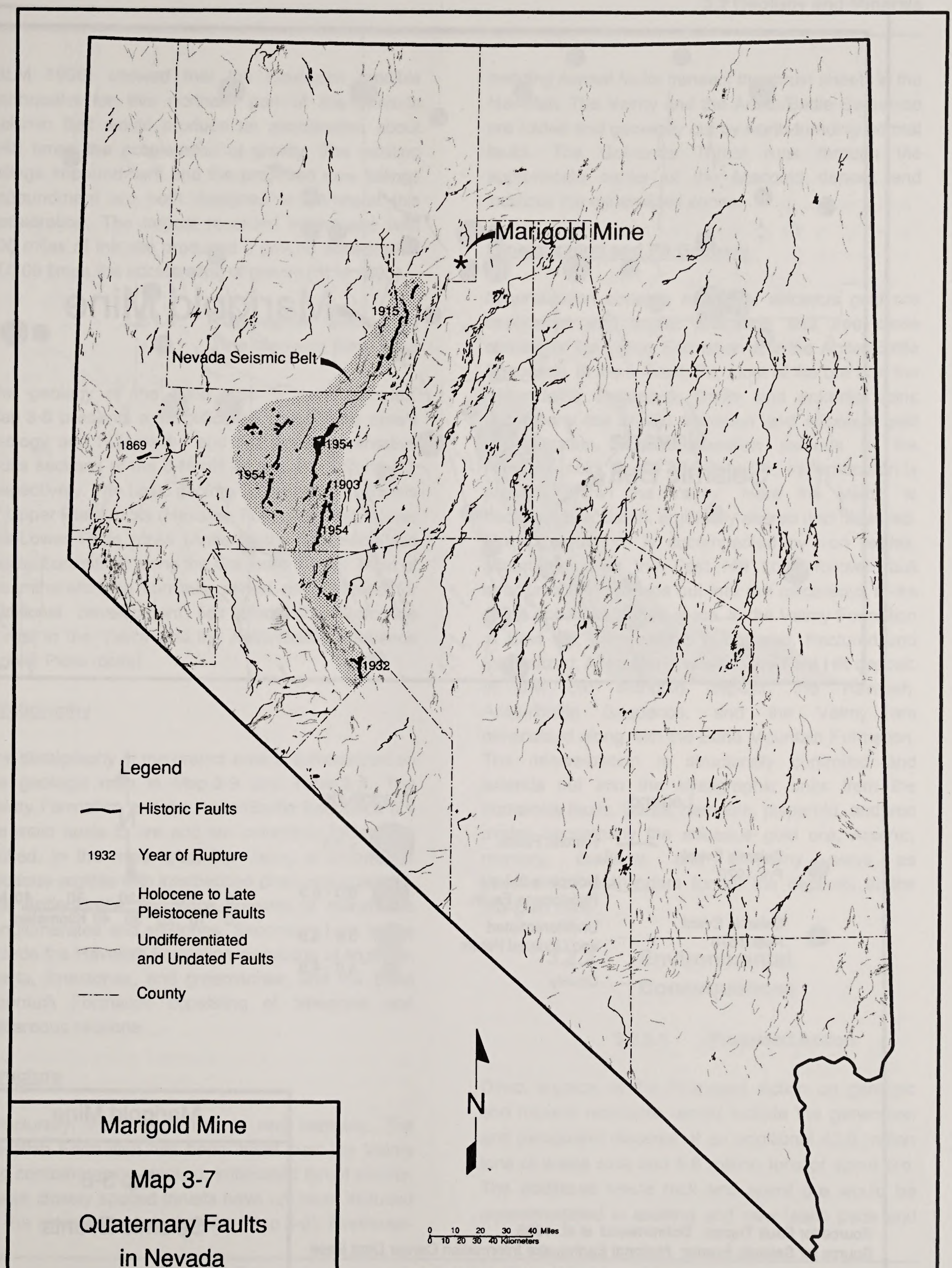
Source: Roberts 1964

N

Marigold Mine

Map 3-6

Regional Geologic Map

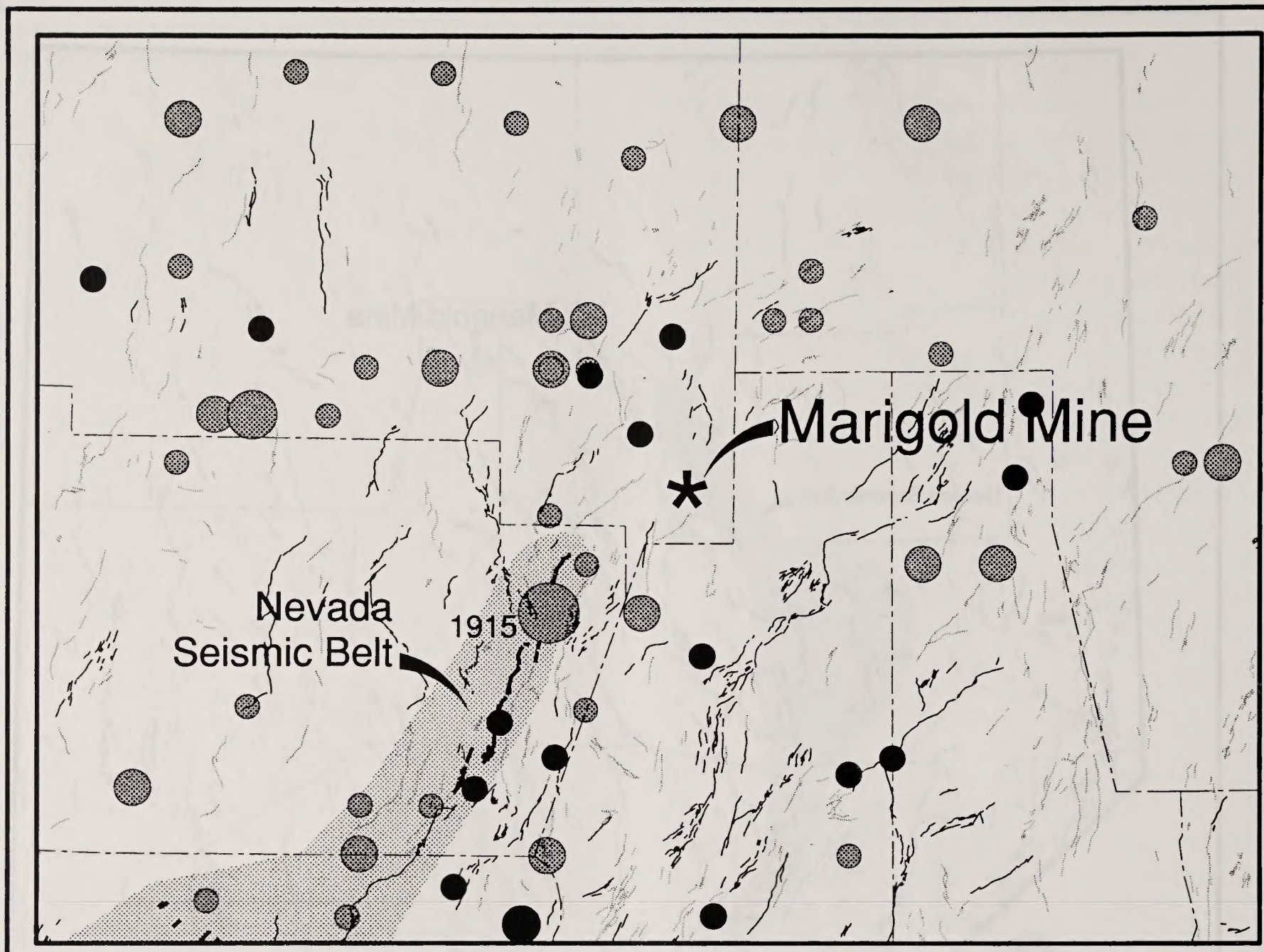



Marigold Mine

Map 3-7

Quaternary Faults in Nevada

Source: Dohrenwend et al. 1995




Legend

- Seismic Event Pre-1970
- Seismic Event Post-1970
- Historic Faults
- Holocene to Late Pleistocene Faults
- Undifferentiated and Undated Faults
- County

Magnitude

- > 7.0
- 6.0 - 6.9
- 5.0 - 5.9
- 4.0 - 4.9

N

0 10 20 30 40 Miles

0 10 20 30 40 Kilometers

Source for Fault Traces: Dohrenwend et al. 1995
Source for Seismic Events: National Earthquake Information Center Data Base

Marigold Mine

Map 3-8

Seismic Events

(BLM 1996) showed that the maximum credible earthquake for this northern part of the Nevada Seismic Belt would produce an acceleration about 0.48 times the acceleration of gravity. The existing tailings impoundment and the proposed new tailings impoundment are both designed to withstand this acceleration. The largest recorded earthquake with 100 miles of the site produced a ground acceleration of 0.09 times the acceleration of gravity (BLM 1996).

#### 3.2.1.8 Geological Setting of the Marigold Mine Area

The geology of the mine area is quite complex. Map 3-9 presents a simplification of the mine area's geology and Figures 3-1 and 3-2 are representative cross sections of the 8-North Pit and the 5-North Pit, respectively. The basic geology of the project consists of Upper Plate rocks (Havallah Formation) thrust over the Lower Plate rocks (Antler/Battle Sequence and Valmy Formation) along the Golconda Thrust. Most of the mineralization currently mined and planned for additional development lies along the Golconda Thrust in the Valmy and the Antler/Battle Sequence (Lower Plate rocks).

**Stratigraphy**

The stratigraphy of the project area is summarized on the geologic map in Map 3-9 and Table 3-7. The Valmy Formation and the Antler/Battle Sequence are the main hosts to ore and are complexly folded and faulted. In the mine area, the Valmy is primarily a siliceous argillite with interbedded chert and quartzite. The Antler/Battle Sequence consists of calcareous conglomerates and siltstones. Secondary host to ore include the Havallah Formation consisting of argillites, cherts, limestones, and greenstones, and the Edna Mountain Formation consisting of limestone and calcareous siltstone.

**Structure**

Structurally, the project area is very complex. The Havallah Formation has been thrust over the Valmy and contains many stacked, imbricated thrust sheets. These closely spaced thrusts have not been included on the simplified geologic map (Map 3-9). Northeast-trending normal faults transect the thrust sheets in the Havallah. The Valmy and the Antler/Battle Sequence are folded and generally cut by north-trending normal faults. The Golconda Thrust runs through the approximate center of the Marigold deposit and localizes the mineralized zones.

**Mineralization and Pit Geology**

Mineralization consists mainly of siliceous gold ore associated with argillic alteration and iron oxide staining of the Valmy Formation and the Antler/Battle Sequence. In the 8-South Pit, most of the ore is in the Antler/Battle Sequence. Barite and ankerite veins accompany the argillic alteration and siliceous gold mineralization. Argillic alteration extends to the Havallah rocks. In the Top Zone Pit, mineralization is primarily within the Valmy. Here the Valmy is fractured, brecciated, argillically altered and bleached. The siliceous ore is accompanied by iron oxides. Mineralization in the East Hill zone follows fault structures and spreads out into the calcareous rocks of the Antler/Battle Sequence. In the Valmy Formation at East Hill, the quartzite is sheared, fractured and mineralized. Alteration is weak in the East Hill deposit. In the Old Marigold deposit, the Havallah, Antler/Battle Sequence, and the Valmy are mineralized along with the Edna Mountain Formation. The mineralization is structurally controlled and extends out into the stratigraphic units from the numerous faults. Barite, hematite, jasperoid, and iron oxides accompany the siliceous gold ore. Arsenic, mercury, ***thallium,*** and antimony serve as geochemical pathfinders for all the deposits at the Marigold Mine.

## 3.2.2 Environmental Consequences

### 3.2.2.1 Proposed Action

Direct impacts of the Proposed Action on geologic and mineral resources would include the generation and permanent disposal of an additional 42.6 million tons of waste rock and 6.8 million tons of spent ore. The additional waste rock and spent ore would be accommodated in existing and new leach pads and

waste rock dumps. A new 54-acre lined tailings impoundment would be added that would support an estimated 0.82 million tons of tailings. Approximately 320,000 ounces of gold would be extracted from the new pits and pit expansions. Condemnation drilling indicates that no known geologic resources would be impacted by the proposed new and expanded waste rock dumps, new and expanded leach pad, and the new tailings impoundment.

#### 3.2.2.2 8-South Partial Pit Backfill Alternative

No additional impacts to geologic and mineral resources beyond those identified for the Proposed Action would occur under this alternative. The same volume of ore and waste rock would be generated and disposed of under this alternative. Backfilling the 8-South Pit would not impact geologic resources at the Marigold Mine since the pit has been mined and no new resources have been identified.

#### 3.2.2.3 No Action Alternative

No impacts to geologic and mineral resources would occur under the No Action Alternative beyond what is currently occurring under existing and approved operations.

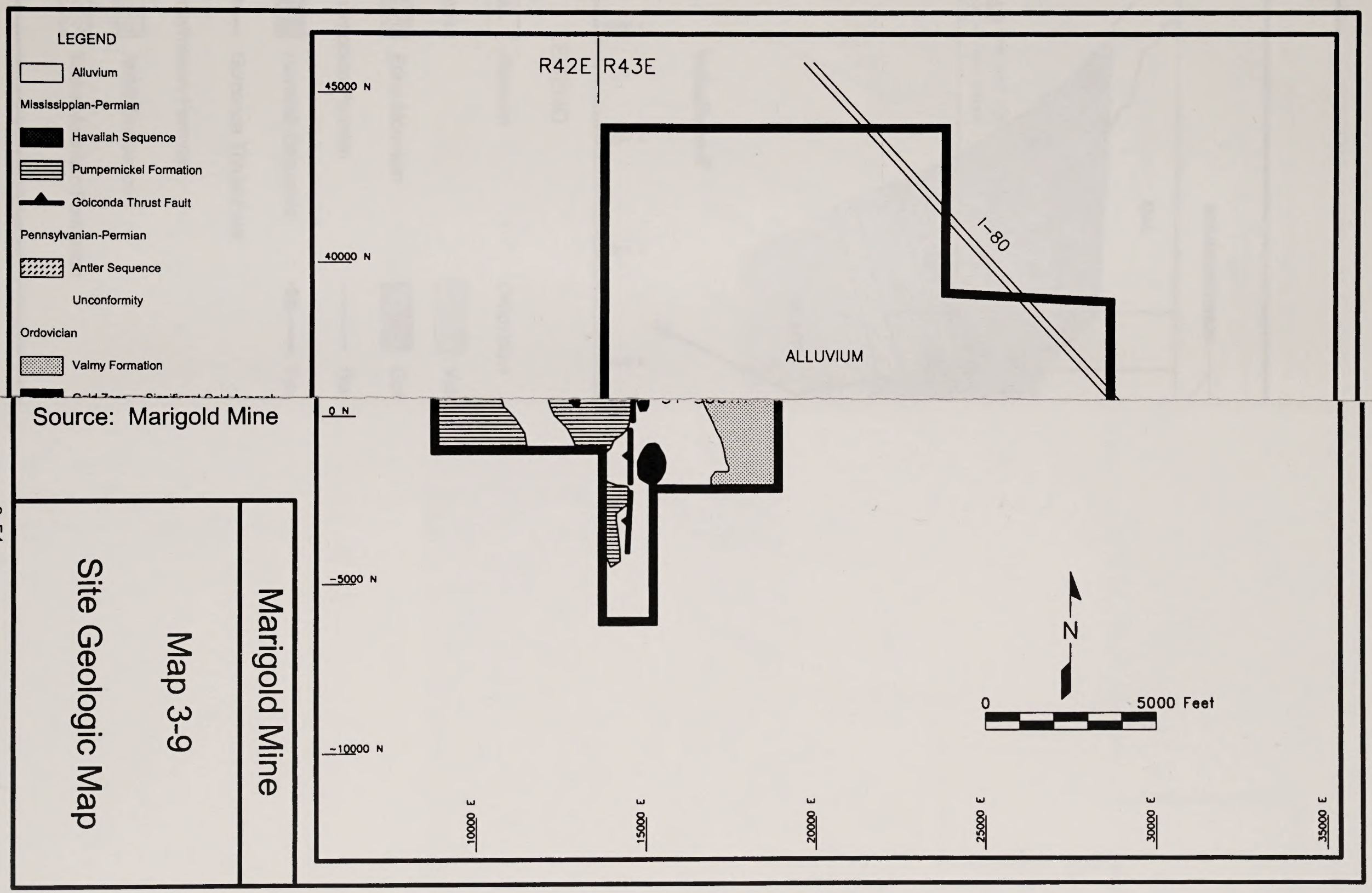
### 3.2.3 Cumulative Impacts

Surface mining affects geology and mineral resources by excavating, modifying, or covering natural topographic and geomorphic features and by removing mineral resources, thereby making these mineral resources unavailable for future use. The cumulative assessment area for geology and mineral resources is shown on Map 3-5 and includes the area from the Lone Tree Mine south to Battle Mountain Gold's Phoenix project. This is an area of current exploration and development of gold deposits.

Historically, this area has been mined for copper, gold, silver, with some minor development of manganese and antimony deposits. The total value of the ore removed in the Battle Mountain Mining District is not known. Mining began in 1866 and has continued to the present with intermittent periods of little or no mining alternating with periods of intense mining activity. Over 400,000 tons of copper-gold ore were removed from the Copper Canyon mine alone between 1866 and 1945. The Battle Mountain Gold complex to date has removed an estimated 2.2 million ounces of gold ore. It is estimated that the Lone Tree Mine will have removed 4.35 million ounces of gold by the time mining ceases around ***2007*** (BLM 1995). Other historical mines in the area have removed lesser amounts of copper, gold and silver ore on an individual basis, but their cumulative total of ore may equal that of the Copper Canyon mine.

The present interest in gold in the Battle Mountain district represents a renewal of intense mining activity in the cumulative assessment area. Major mines in the area are shown on Map 3-5. Battle Mountain Gold's Phoenix project, the Lone Tree Mine, the Margiold Mine, and the recently discovered Trenton, Valmy, and North Peak deposits (Trenton Canyon project) represent the major present and future mining impacts to the area. The Lone Tree Mine is expected to operate until around ***2007*** and remove about 555 million tons of ore and waste rock (BLM 1995). The Phoenix project is expected to remove an estimated 1.15 billion tons of ore and waste rock containing approximately 7 million ounces of gold. The Trenton Canyon project will remove an estimate 152 million tons of ore and waste rock from at least 3 separate deposits (BLM 1998). The Marigold Mine, when completed around ***2007***, will have removed an estimated 198.6 million tons of ore and overburden.

The primary geologic impact of mining is the permanent removal and loss of mineral resources. These resources are thus not available for future generations. Condemnation drilling is generally used to identify areas of no potential future economic value before waste rock dumps, tailings impoundments, and leach pads are constructed. The surface disturbances that remain after mining usually do not result in an additional loss of mineral resources to future generations. Operations at the Marigold Mine under the Proposed Action are expected to remove all




Source: Marigold Mine

Marigold Mine

Map 3-9

Site Geologic Map

waste rock dumps. A new 54-acre lined tailings impoundment would be added that would support an estimated 0.82 million tons of tailings. Approximately 320,000 ounces of gold would be extracted from the new pits and pit expansions. Condemnation drilling indicates that no known geologic resources would be impacted by the proposed new and expanded waste rock dumps, new and expanded leach pad, and the new tailings impoundment.

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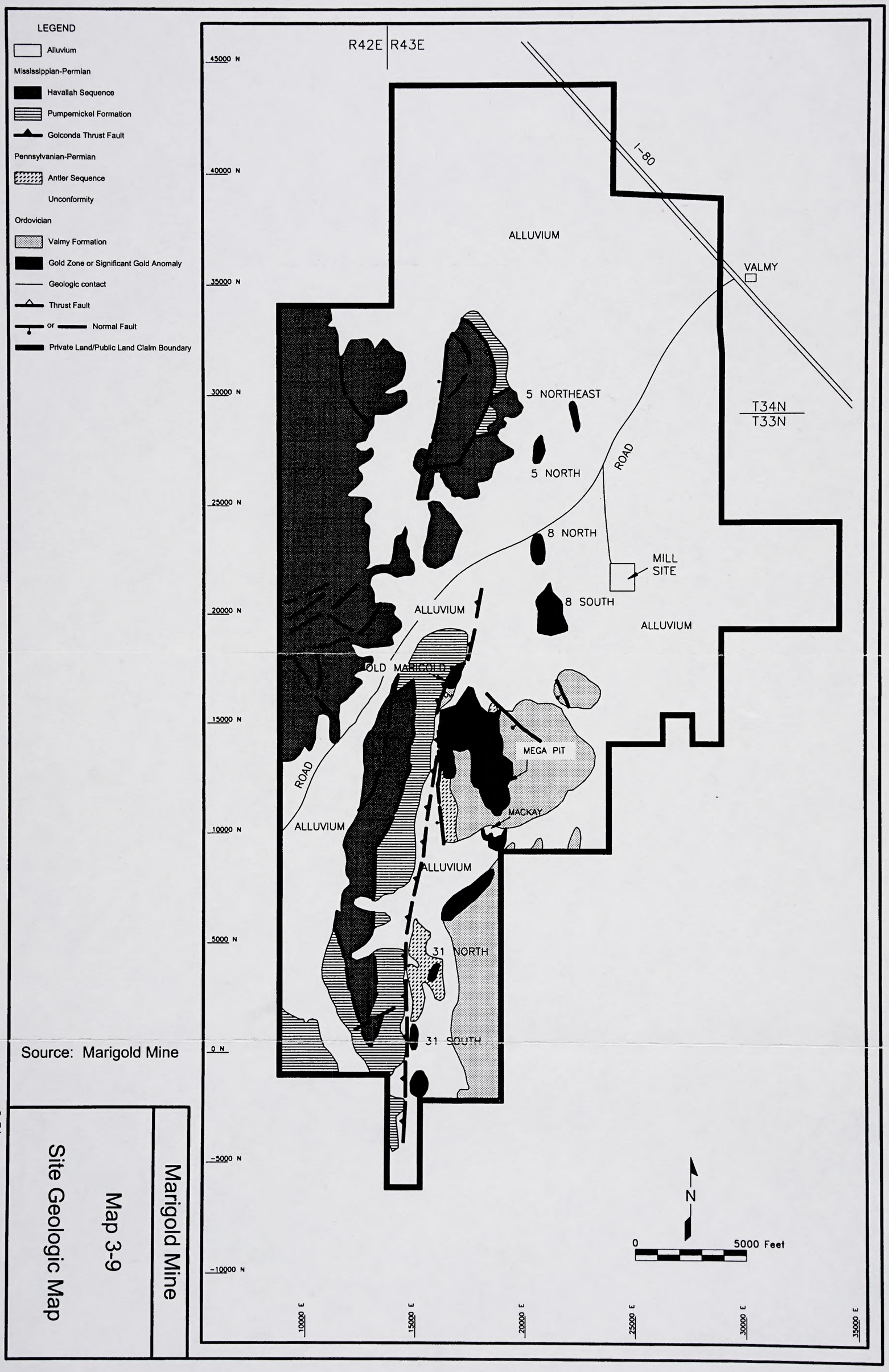
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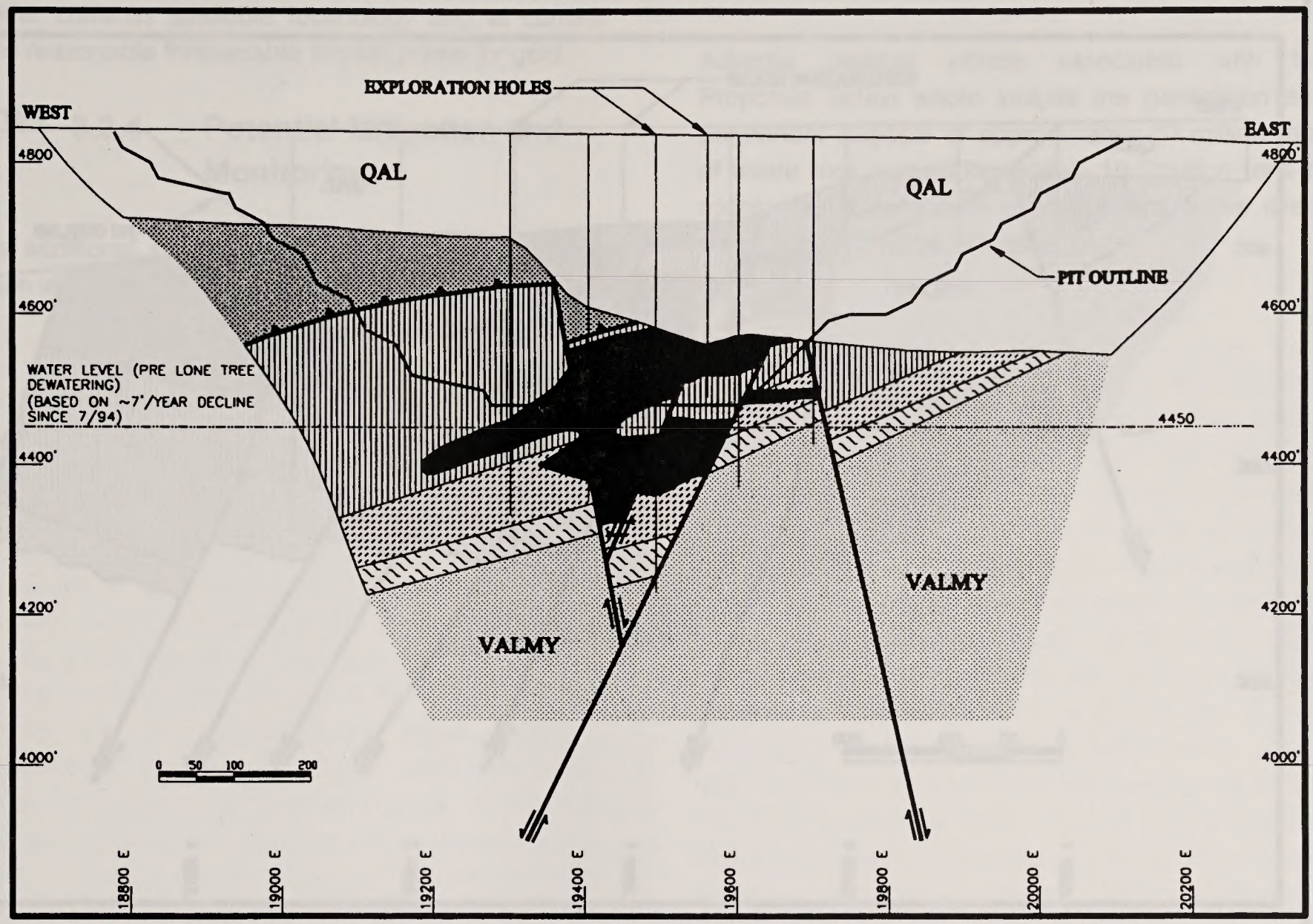

Source: Marigold Mine

Marigold Mine

Map 3-9

Site Geologic Map






LEGEND

QAL Alluvium

Permian

Edna Mountain

Mississippian-Permian

Havallah Sequence

Golconda Thrust Fault

Pennsylvanian-Permian

Antler Sequence

Battle Mountain Formation

Ordovician

Valmy Formation

Gold Zone or Significant Gold Anomaly

Geologic contact

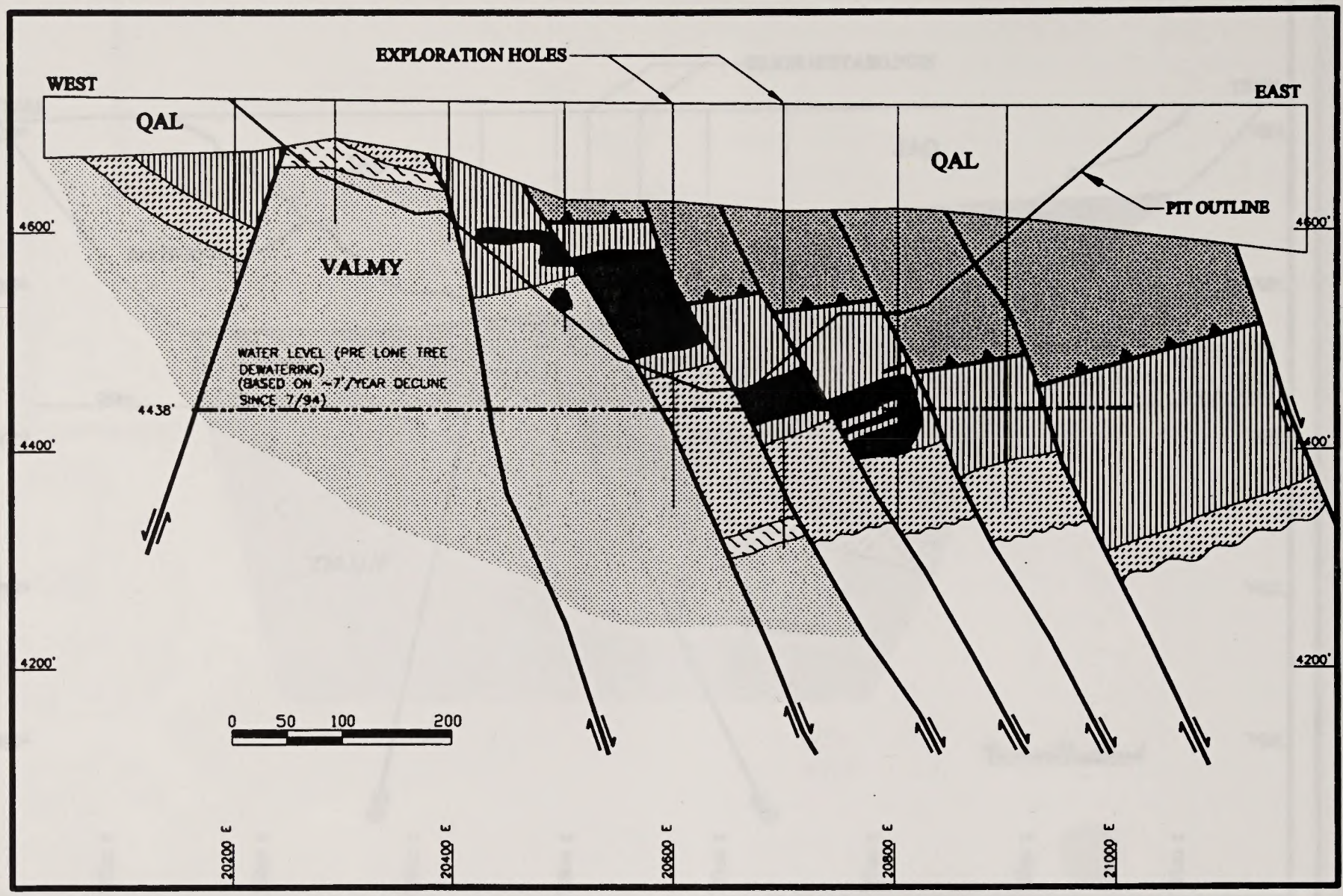
Fault

Source: Marigold Mine

Marigold Mine

Figure 3-1

Geologic Cross-Section for 8-North Pit




LEGEND

| | |
|---|---|
| QAL Alluvium | Ordovician |
| Permian | Valmy Formation |
| Edna Mountain | Gold Zone or Significant Gold Anomaly |
| Mississippian-Permian | Geologic contact |
| Havallah Sequence | Fault |
| Golconda Thrust Fault | |
| Pennsylvanian-Permian | |
| Antler Sequence | |
| Battle Mountain Formation | |

Source: Marigold Mine

Marigold Mine

Figure 3-2

Geologic Cross-Section for 5-North Pit

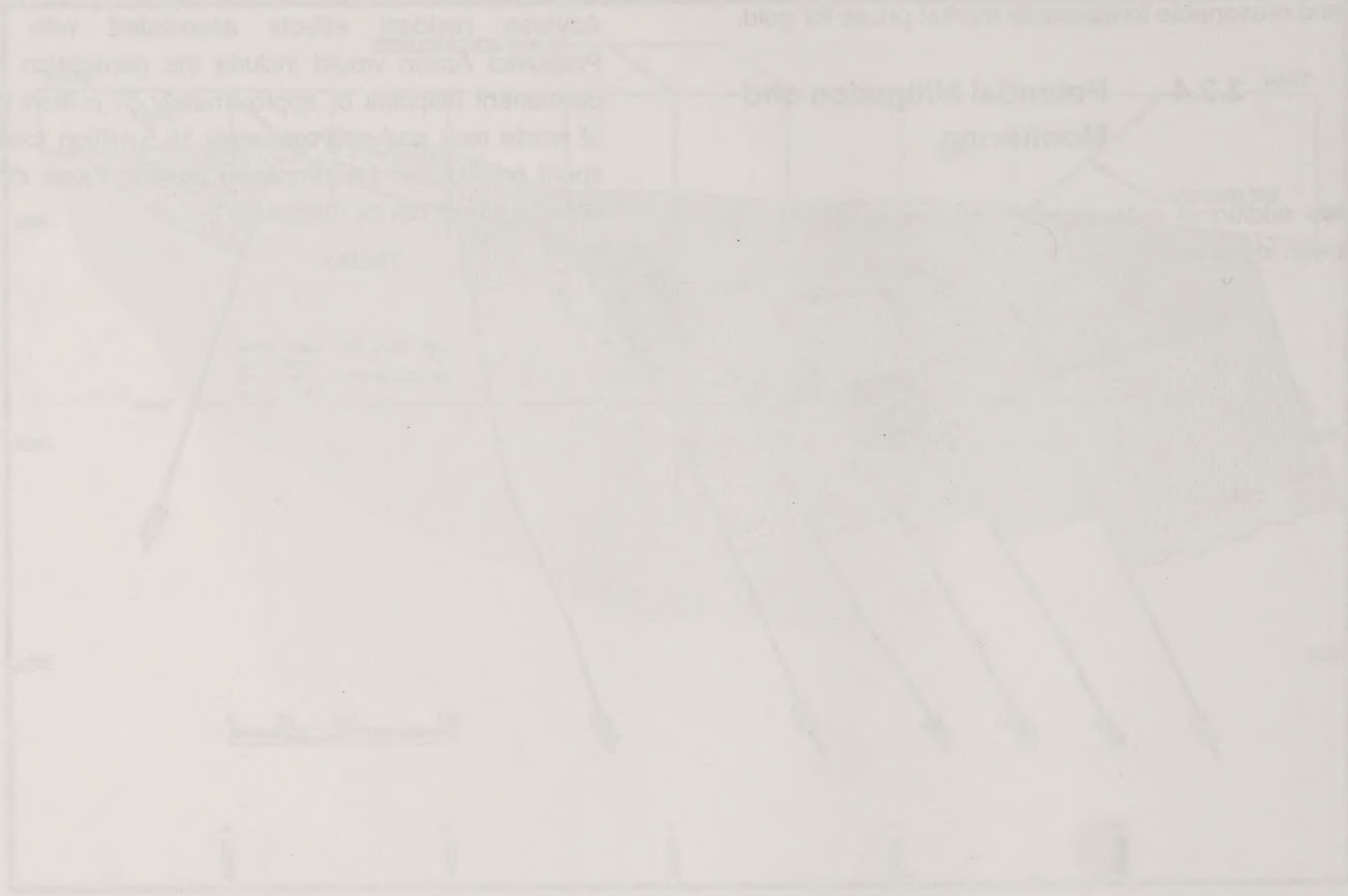
mineral resources that can be economically extracted under currently available technology and at current and reasonable foreseeable market prices for gold.

### 3.2.4 Potential Mitigation and Monitoring

No additional mitigation or monitoring needs have been identified.

### 3.2.5 Residual Adverse Impacts

Adverse residual effects associated with the Proposed Action would include the generation and permanent disposal of approximately 57 million tons of waste rock and approximately 19.5 million tons of spent ore. Under the proposed project, these direct impacts would not be mitigated.



Marigold Mine

Figure 3-2

Geologic Cross-Section
for S-Horst Pit

# 3.3 Air Quality

## 3.3.1 Affected Environment

The proposed Marigold Mine expansion project area is located near the east-central portion of the Great Basin. The surrounding terrain consists of alternating mountain ranges and sagebrush-covered valleys, with the mine site situated in Hydrographic Area ***64***, which also is the designated air basin. Mountains in the region of the mine site include highest peaks reaching elevations over 9,000 feet (amsl). Elevations in the project vicinity range from approximately 5,500 feet to over 7,500 feet (amsl).

Baseline meteorology, air quality, and dispersion conditions at the project site are characterized from ambient monitoring data taken during 1993-94 at nearby Lone Tree Mine, and from the Valmy Power Station located approximately 5 miles north of the project area. The climate in the project region is classified as semi-arid or steppe. Elevations below 5,000 feet receive the least amount of precipitation and are generally described as arid or desert climatic zones. The mountainous areas are significantly wetter receiving 11 to over 15 inches of precipitation annually. An arid climate is characterized by low rainfall, low humidity, clear skies, and relatively large annual and diurnal temperature ranges.

Because of the typically dry atmosphere, bright sunny days and clear nights occur frequently. Clear skies allow rapid heating of the ground surface during daylight hours and rapid cooling at night. Since heated air rises and cooled air sinks, winds tend to blow uphill during the daytime and downslope at night. This upslope and downslope cycle generally occurs in all the geographical features, including mountain range slopes and river courses. The larger the horizontal extent of the feature, the greater the volume of air that moves in the cycle. Complexity of the terrain features causes complex movements in the cyclic air patterns, with thin layers of moving air embedded within the larger scale motions. The lower-level, thermally driven winds are also embedded within larger scale upper wind systems (synoptic winds). Synoptic winds in the region blow predominantly west to east, are characterized by daily weather variations which enhance or diminish the boundary layer winds, and are significantly channeled by regional and local topography. Terrain features affect both wind speed and wind direction.

### 3.3.1.1 Climatology and Meteorology

Three important meteorological factors influence the dispersion of pollutants in the atmosphere: mixing height, wind (speed and direction), and stability. Mixing height is the height above ground within which rising warm air from the surface will mix by convection and turbulence. The degree to which pollutants are diluted in this mixed layer is determined by local atmospheric conditions, terrain configuration, and source location. Mixing heights vary diurnally, with the passage of weather systems, and with season. For the project area, the mean annual morning mixing height is estimated to be about 300 meters, but during the winter months the mean morning mixing height is about 220 meters (Holzworth 1972). The mean annual afternoon mixing height exceeds 2,400 meters.

Morning atmospheric stability conditions tend to be stable because of the rapid cooling of the layers of air nearest the ground. Afternoon conditions, especially during the warmer months, tend to be neutral to unstable because of the solar heating of the surface under clear skies. During the winter, periods of stable afternoon conditions may persist for several days in the absence of synoptic scale storm systems to generate higher winds with more turbulence and mixing. A high frequency of inversions at lower elevations during the winter can be attributed to the nighttime cooling and sinking air flowing from higher elevations to the low lying areas in the basins. Although winter inversions are generally quite shallow, they tend to be more stable because of reduced surface heating. The mine site is located at higher elevations and would experience fewer

episodes with stagnant conditions than locations in lower valleys.

The proposed project is located at a latitude that places it within the belt of prevailing westerly winds that circle the globe around the earth's northern hemisphere. However, the mine site is located in complex terrain where the local winds are affected by topographic features.

High quality meteorological data are collected on a routine basis at the Valmy Power Station located about 5 miles north of the mine site. Winds were measured on a multi-level tower at 10, 50, and 100 meters at Valmy, and quarterly wind roses for the 10-meter level are shown in Figure 3-3. These data show the percentage of time that the wind blows from a particular direction. For the project site, the most frequently observed wind direction is from the northwest.

Wind speed has an important effect on area ventilation and the dilution of pollutant concentrations from individual sources. Light winds, in conjunction with large source emissions, may allow pollutants to accumulate and stagnate or move slowly to downwind areas. During stable conditions, downwind usually means down valley or toward lower elevations. Climatological data from the region (Winnemucca) indicate that the potential for air pollution episodes to last 5 or more days is nearly zero (Holzworth 1972). A potential air pollution episode is defined as a period of time with wind speeds less than 2 meters per second and mixing heights less than 1,000 meters.

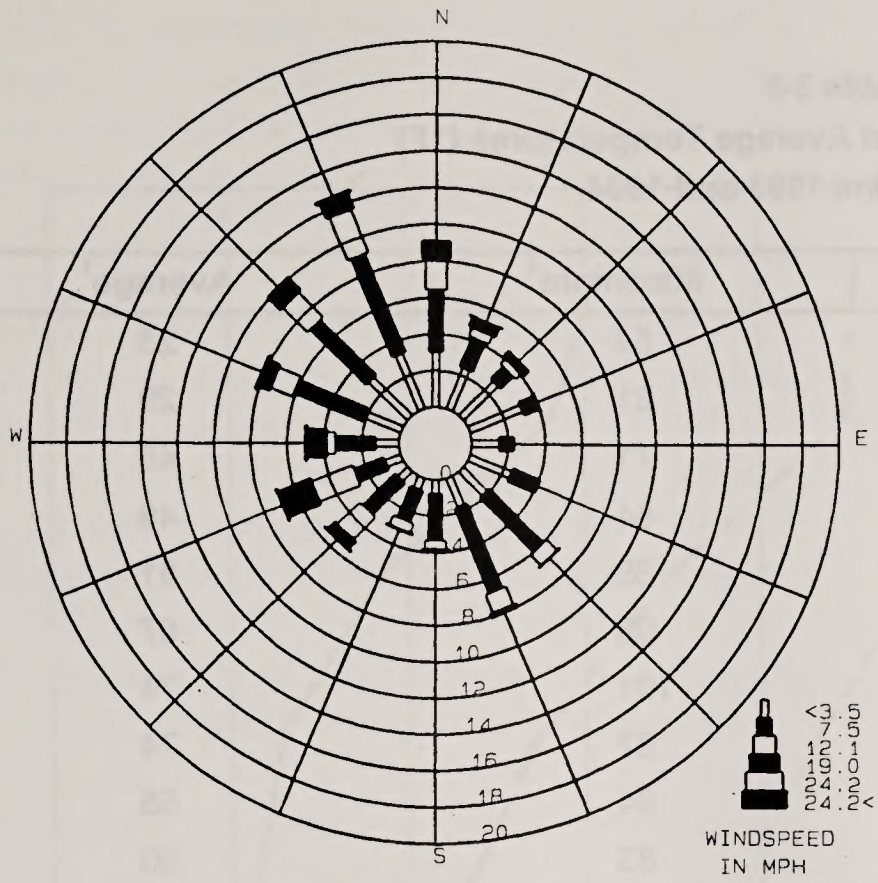
Although weather conditions are not monitored at the mine site, average temperatures would be similar to those experienced at Lone Tree Mine located about 8 miles northwest of the Marigold mine and located at about the same elevation. At the Lone Tree mine site temperatures range from the 20s (°F) in January to mostly the 90s in July, although temperatures in excess of 100 are sometimes observed. Table 3-8 and Figure 3-4 depict maximum, average, and minimum temperatures at the Lone Tree mine during the period January 1993 through December 1994.

Summers are typically hot and dry except in the higher mountain ranges. Although precipitation is spread throughout the year, most of the annual precipitation will fall as snow during the winter months. The average annual precipitation is only about 9 inches at Winnemucca. Precipitation totals by month for Marigold Mine for the period from September 1993 through August 1999 are presented in Table 3-9. These on-site data indicate that the mine receives about the same or somewhat higher amounts than Winnemucca. Average relative humidity ranges from a low of 17 percent in the summer during the day to a high of 77 percent in spring during the night (NOAA 1990). Net evaporation exceeds precipitation in the project area.

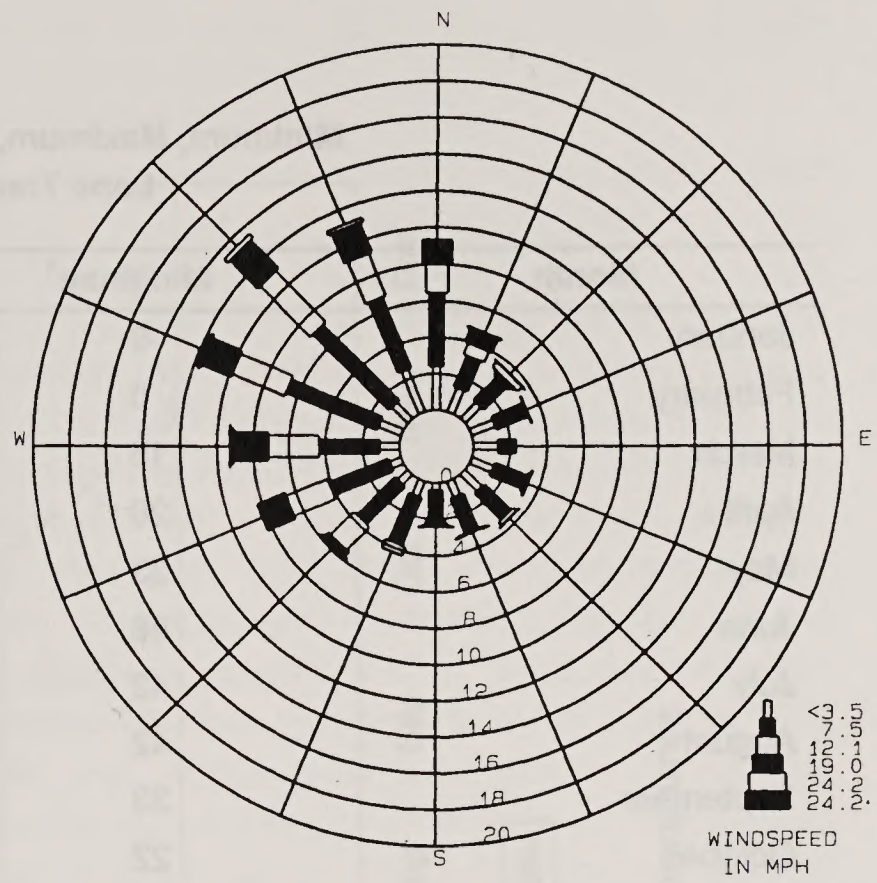
#### 3.3.1.2 Air Quality

Air quality is defined by the concentration of various pollutants and their interactions in the atmosphere. Pollution effects on human and environmental receptors have been used to establish a definition of air quality. Measurement of pollutants in the atmosphere is expressed in units of parts per million (ppm) or micrograms per cubic meter (μg/m3). Both long-term climatic factors and short-term weather fluctuations are considered part of the air quality resource because they control dispersion and affect concentrations. Physical effects of air quality depend on the characteristics of the receptors and the type, amount, and duration of exposure. Air quality standards specify acceptable upper limits of pollutant concentrations and duration of exposure. Air pollutant concentrations within the standards are generally not considered to be detrimental to public health and welfare.

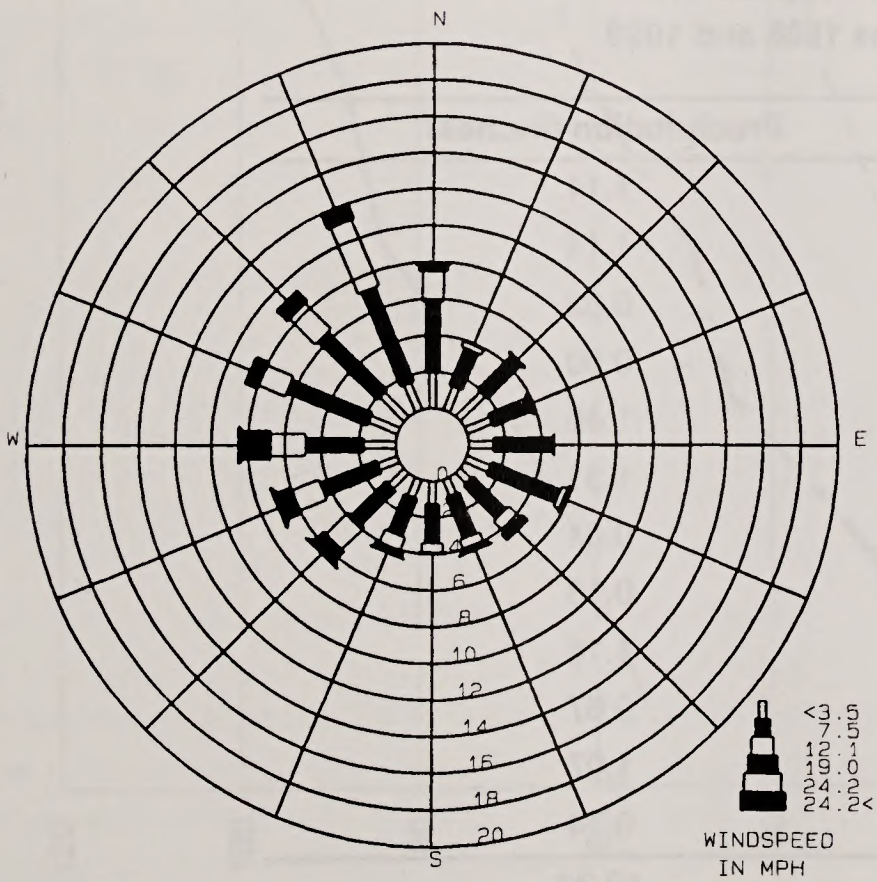
The relative importance of pollutant concentrations can be determined by comparison with an appropriate national and/or state ambient air quality standard. National and state ambient air quality standards are presented in Table 3-10. An area is designated by



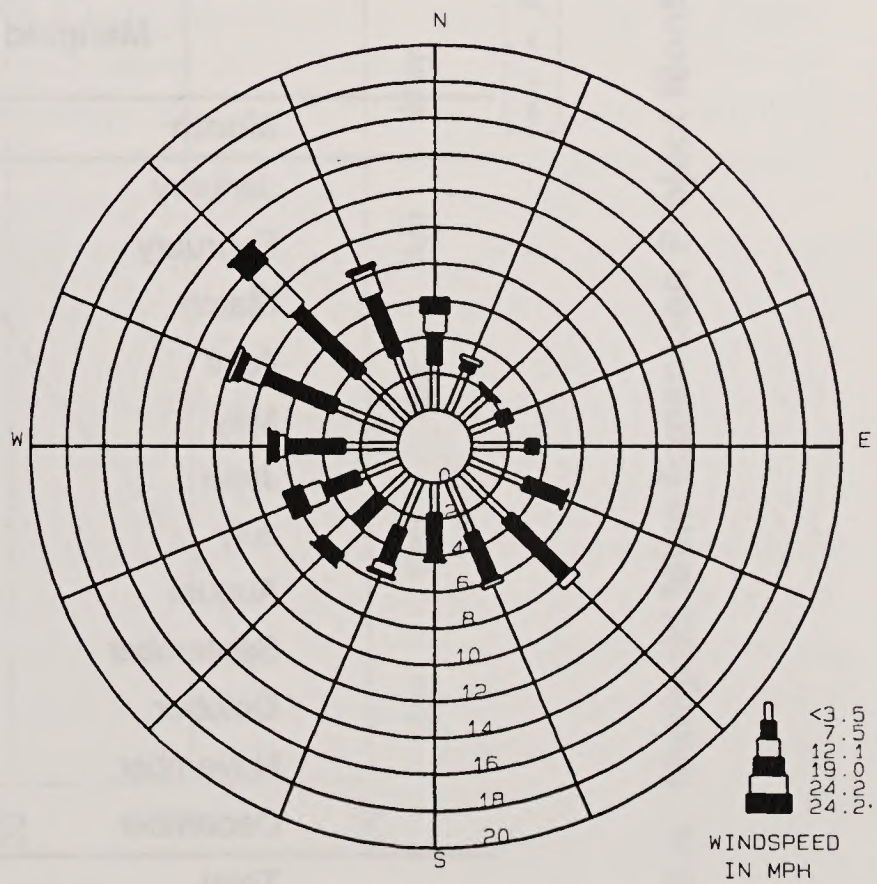

10-Meter Wind Rose Analysis
January 1997 - March 1997




10-Meter Wind Rose Analysis
April 1997 - June 1997




10-Meter Wind Rose Analysis
July 1997 - September 1997




10-Meter Wind Rose Analysis
October 1997 - December 1997

Figure 3-3. Valmy Wind Roses January - December 1997

**Table 3-8**
**Minimum, Maximum, and Average Temperatures (°F)**
**Lone Tree Mine 1993 and 1994**

| Month | Minimum[1] | Maximum[1] | Average[1] |
|---|---|---|---|
| January | -9 | 54 | 25 |
| February | 0 | 61 | 29 |
| March | 15 | 71 | 45 |
| April | 26 | 84 | 49 |
| May | 33 | 88 | 61 |
| June | 38 | 95 | 67 |
| July | 42 | 101 | 74 |
| August | 42 | 97 | 74 |
| September | 33 | 94 | 65 |
| October | 22 | 83 | 50 |
| November | 0 | 64 | 31 |
| December | 6 | 58 | 29 |
| Annual | 21 | 79 | 50 |

[1]Temperatures are for the period 1993-1994.

**Table 3-9**
**Monthly Precipitation**
**Marigold Mine 1998 and 1999**

| Month | Precipitation (inches)[1] |
|---|---|
| January | 1.11 |
| February | 1.14 |
| March | 0.62 |
| April | 0.90 |
| May | 1.40 |
| June | 1.31 |
| July | 0.01 |
| August | 0.13 |
| September | 1.16 |
| October | 0.67 |
| November | 1.07 |
| December | 0.74 |
| Total | 10.26 |

[1]Precipitation is the total observed each month starting in September 1998 through August 1999.

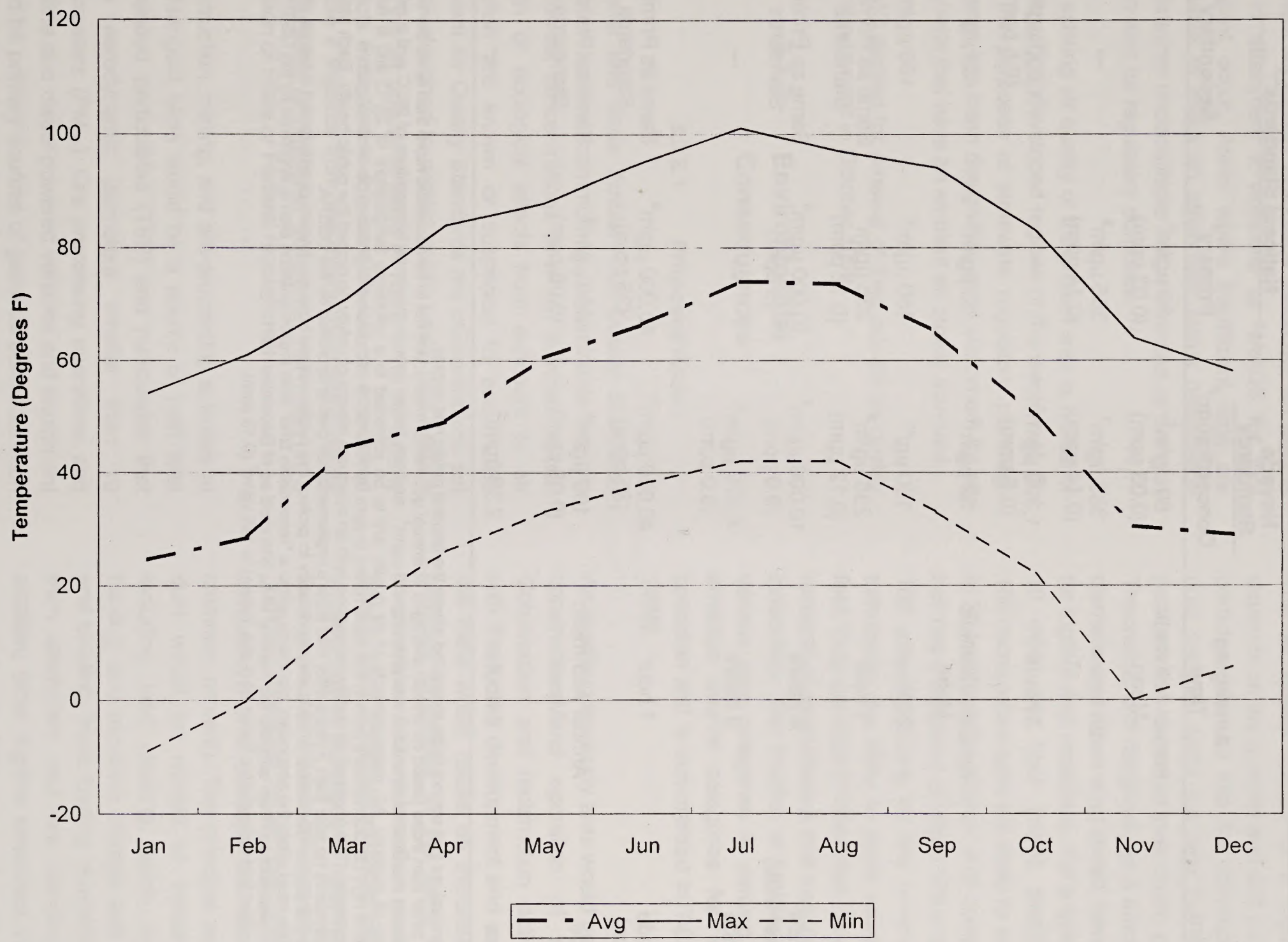



**Figure 3-4. Marigold Mine Expansion Project Monthly Regional Temperatures**

**Table 3-10**
**National and State Ambient Air Quality Standards**

| Pollutant | Averaging Time | Nevada Standards[1] | National Standards[2,3] | |
|---|---|---|---|---|
| | | Concentration[3] | Primary[4] | Secondary[5] |
| Sulfur Dioxide | Annual Arithmetic Mean | 80 μg/m$^3$ (0.03 ppm) | 80 μg/m$^3$ (0.03 ppm) | --- |
| | 24 hours | 365 μg/m$^3$ (0.14 ppm) | 365 μg/m$^3$ (0.14 ppm) | --- |
| | 3 hours | 1,300 μg/m$^3$ (0.5 ppm) | --- | 1,300 μg/m$^3$ (0.5 ppm) |
| $PM_{10}$[6] | Annual Arithmetic Mean | 50 μg/m$^3$ | 50 μg/m$^3$ | 50 μg/m$^3$ |
| | 24 hour | 150 μg/$^m$ | 150 μg/m$^3$ | 150 μg/m$^3$ |
| Ozone[7] | 1 hour | 235 μg/m$^3$ (0.12 ppm) | 235 μg/m$^3$ (0.12 ppm) | Same as Primary Standards |
| Carbon Monoxide (below 5,000 feet MSL) | 8 hours | 10,000 μg/m$^3$ (9.0 ppm) | 10,000 μg/m$^3$ (9 ppm) | Same as Primary Standards |
| Carbon Monoxide (at or above 5,000 feet MSL) | 8 hours | 6,670 μg/m$^3$ (6.0 ppm) | --- | --- |
| Carbon Monoxide (at any elevation) | 1 hour | 40,000 μg/m$^3$ (35 ppm) | 40,000 μg/m$^3$ (35 ppm) | Same as Primary Standards |
| Nitrogen Dioxide | Annual Arithmetic Mean | 100 μg/m$^3$ (0.05 ppm) | 100 μg/m$^3$ (0.05 ppm) | Same as Primary Standards |
| Crystalline Silica | 8 hours | 2.38 μg/m$^3$ | --- | --- |

[1]Nevada standards are values that are not to be exceeded where the general public has access.
[2]National standards, other than those based on annual averages or annual geometric means, are not to be exceeded more than once per year.
[3]Concentration expressed first in units in which it was promulgated μg/m$^3$, and are based upon a reference temperature of 25°C and a reference pressure of 760 mm of mercury. All measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 mm of Hg (1,013.2 millibar); ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.
[4]National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health. Each state must attain the primary standards no later than 3 years after that state's implementation plan is approved by the USEPA.
[5]National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Each state must attain the secondary standards within a "reasonable time" after implementation plan is approved by the USEPA.
[6]The Nevada State Implementation Plan adopted the Federal $PM_{10}$ Standard as of December 1991.
[7]The state ozone standard for Hydrographic Basin 90 (Lake Tahoe) is 195 μg/m$^3$ (0.10 ppm).

the U.S. Environmental Protection Agency (USEPA) as being in attainment for a pollutant if ambient concentrations of that pollutant are below the National Ambient Air Quality Standards (NAAQS). An area is not in attainment if violations of NAAQS for that pollutant occur. Areas where insufficient data are available to make an attainment status designation are listed as unclassifiable and are treated as being in attainment for regulatory purposes.

The existing air quality of the project area is typical of the largely undeveloped regions of the western U. S. For the purposes of statewide regulatory planning, this area has been designated as in attainment for all pollutants that have an ambient air quality standard.

GMMC applied for renewal of their current air quality operating permit in October 1999.

## 3.3.2 Environmental Consequences

### 3.3.2.1 Proposed Action

National and State Ambient Air Quality Standards establish levels of common air contaminants that are the lowest concentrations at which adverse human health or ecological effects from exposure to air pollution are known or suspected to occur. The Ambient Air Quality Standards are concentrations set by law designed to protect public health and welfare from the air pollutants listed in Table 3-10. Air quality impacts evaluated in this analysis will be considered notable if impacts from the mining operations cause an increase of regulated pollutants that result in a violation of State or Federal regulations.

Construction, mining, and ore-processing activities at the Marigold Mine would be a source of both total suspended particulates (TSP) and particulates that have aerodynamic diameters smaller than 10 micrometers ($PM_{10}$). Ore processing operations and gasoline and diesel-powered vehicles and equipment would be primary sources of gaseous pollutants such as sulfur dioxide ($SO_2$), oxides of nitrogen ($NO_2$), carbon monoxide (CO), and volatile organic compounds (VOCs).

The air quality impact of a fugitive dust source depends on the quantity and drift potential of the dust particles released into the atmosphere. The larger dust particles settle out near the source, while fine particles are dispersed over much greater distances. Theoretical drift distances, as a function of particulate diameter and mean wind speed, have been computed for fugitive dust emissions. For a typical wind speed of 10 miles per hour (mph), particles larger than 100 micrometers (μm) are likely to settle out within 20 to 30 feet from the source. (For comparison, a human hair has a thickness of about 100 μm.) Particles 30 to 100 μm, depending on the extent of atmospheric turbulence, are likely to settle within a few hundred feet. Dust particles smaller than 30 μm are generally recognized as emissions that may remain suspended indefinitely. The fraction of fugitive emissions in the various size categories is derived from the major emission source categories for a typical mining operation and is summarized in Table 3-11 (USEPA ***1998)***.

Air quality in the study area would be affected by both construction and operation of mining facilities. Construction and reclamation activities associated with the further development and eventual closing of the mine would cause an increase in fugitive and gaseous emissions in the local area during the construction and reclamation phases. Air quality effects from construction would result in temporary impacts due to increases in local fugitive dust levels. Dust generated from these open sources is termed "fugitive" because it is not discharged to the atmosphere in a confined flow stream (e.g., stack, chimney, or vent). The principal sources of fugitive dust would be related to construction activities, including land clearing, earth moving, scraping, hauling, and materials storage and handling; drilling and blasting; truck loading operations; wind erosion from stockpiles; and ore handling operations. In addition, other fugitive emissions impacts would be caused by mud/dirt carryout onto paved surfaces.

**Table 3-11**
**Marigold Mine Expansion Project**
**Estimated Particle Size Distribution**

| | Diameter (μm) | | | | | |
|---|---|---|---|---|---|---|
| Process | <2.5 | 2.5-5.0 | 5.1 – 10.0 | 10.1 - 15.0 | 15.1 - 30.0 | >30.0 |
| Material Handling | 0.13 | 0.10 | 0.13 | 0.12 | 0.25 | 0.27 |
| Unpaved Roads | 0.10 | 0.10 | 0.16 | 0.14 | 0.30 | 0.20 |
| Composite | 0.11 | 0.10 | 0.14 | 0.13 | 0.28 | 0.24 |

Source: USEPA 1998.

The additional surface loading would cause an increase in fugitive emissions during the lifetime of the construction project.

During construction and reclamation, vehicle exhaust emissions would be generated but such emissions are small compared to fugitive emissions from earth moving, hauling and other construction activities and would not affect regional air quality. Particulate levels from construction and reclamation activities would vary, and impacts would depend on the activity location and the daily wind and weather. These activities would require a surface disturbance permit from NDEP, which would require that appropriate measures be taken to limit fugitive dust emissions. While mitigation measures required by the NDEP Air Quality Bureau would reduce the amount of emissions from such activities, some level of fugitive dust emissions would be unavoidable due to the nature of the work. Although some impacts on air quality would inevitably occur during construction and reclamation, they would be transitory and temporary, limited in duration, and would end at the completion of that particular phase of the work. Once reclamation was completed, pollutant concentrations would return to background levels.

Air quality impacts due to emissions from mining operations would occur throughout the operational phase of the project. The primary pollutant would be fugitive dust particulates (TSP and $PM_{10}$) generated by the crushers, screens, conveyors, tailings impoundments, haul roads, and other processes. Other pollutants include $NO_2$, CO, and $SO_2$ from exhaust emissions from the vehicles, and other fuel burning equipment. Volatile organic compounds are emitted from fuel storage tanks.

All criteria pollutant emission rates (not including fugitive dust) are less than 250 tons per year (tpy); therefore, the mine is not a "major stationary source" as defined by the USEPA. Air pollutant sources are deemed "major" for Prevention of Significant Deterioration (PSD) purposes if their emissions exceed 250 tpy. The planned mine expansion would result in an increase of gaseous pollutants, but each type would be less than 2 tpy, well below the 250 tpy threshold for PSD. ***The planned mine expansion would result in gaseous emissions for approximately 5 additional years.*** Emissions of particulates from all individual sources at the mine facilities would be less than 100 tpy and would not be classified as a major source under Title V of the Clean Air Act. Hazardous air pollutants (HAPs) emissions would be less than 10 tons per year for each individual pollutant and less than 25 tons per year for all HAPs combined ***(Table 3-12)***. ***Emissions from the existing mill have been identified in Table 3-13. Currently portions of the mill are operating on an intermittent basis with high grade ore being stockpiled for future milling.***

***Mercury is a pollutant that may affect the nervous system of humans and wildlife and bio-accumulates in food chains. Mercury is released into the environment through natural and man-***

*Table 3-12*
*Hazardous Air Pollutants (HAPs) Potential to Emit[1]*

| *HAP* | *Point Source* | *Fugitive* | *Total* |
|---|---|---|---|
| *Antimony* | *0.005* | *0.126* | *0.13* |
| *Arsenic* | *0.015* | *2.606* | *2.62* |
| *Beryllium* | *0.005* | *0.011* | *0.02* |
| *Cadmium* | *0.006* | *0.010* | *0.02* |
| *Chromium* | *0.008* | *1.202* | *1.21* |
| *Cobalt* | *0.005* | *0.071* | *0.08* |
| *Lead* | *0.458* | *0.216* | *0.67* |
| *Manganese* | *0.013* | *1.597* | *1.61* |
| *Mercury[2]* | *0.044* | *0.003* | *0.047* |
| *Nickel* | *0.007* | *0.466* | *0.47* |
| *Selenium* | *0.006* | *0.259* | *0.27* |
| *HCN* | *0.026* | *0.000* | *0.03* |
| *Benzene* | *0.010* | *0.006* | *0.02* |
| *Dichlorobenzene* | *0.000* | *0.000* | *0.00* |
| *Formaldehyde* | *0.006* | *0.008* | *0.01* |
| *Hexane* | *0.222* | *0.000* | *0.22* |
| *Toluene* | *0.121* | *0.003* | *0.12* |
| *Total HAPs (tpy)* | *0.957* | *6.584* | *7.55* |

*[1]Potential to emit calculations are based on maximum permitted values or ratio-up factors.*
*[2]Mercury emissions are based on engineering calculations of processed ore for a typical year.*

**Table 3-13**
**Potential to Emit**
**(tpy)**

| Pollutant | Point Sources | Fugitive sources | Total |
|---|---|---|---|
| $PM_{10}$ | 34.46 | 3714.87 | 3749.33 |
| $SO_2$ | 0.005 | 0.004 | 0.01 |
| CO | 0.44 | 0.01 | 0.45 |
| VOC | 1.05 | 0.01 | 0.45 |
| $NO_2$ | 1.73 | 0.06 | 1.80 |
| HAP | ***0.95*** | 6.60 | ***7.55*** |

***made processes. The metal mining industry began reporting estimates of mercury releases as part of the Toxic Release Inventory to the EPA in 1998. Mercury emissions from mining operations generally originate from processing the ore. Ore roasters and autoclaves can be point sources of air mercury emissions. The Marigold Mine does not utilize roasters or autoclaves to process ore. However, residual mercury emissions may be generated as a by-product from the mercury retort and through other processing within the mill circuit. Mercury released to the atmosphere as a vapor may travel long distances or be deposited relatively close to the source dependent on what species of mercury is being emitted (Elemental metallic mercury, [$Hg^0$] or Mercury 2 [$Hg^2$]).***

The highest potential to emit for a criteria pollutant would be $PM_{10}$ at 34.46 tpy. Total combined HAPs are projected to be ***7.6*** tpy. The highest individual HAP ***potential to emit*** would be ***lead***; the estimated value is ***0.46*** tpy. ***Potential mercury emissions are based on engineering estimates and processed ore throughput at the mine for a typical year and are less than 0.05 tpy. BLM has used NAAQS in the impact analysis for this EIS. The proposed project would comply with NAAQS per the NDEP Air Quality Permit #AP104109158. There are no NAAQS for mercury or arsenic. However, no other adverse impacts from mercury emissions have been identified through this NEPA analysis. There is currently insufficient information available as to the distribution of elemental and oxidized mercury from gold mining operations.*** These emission levels qualify the mine as a minor source of air contaminants. Fugitive emissions associated with the heap leach pads are expected to be near zero. Cyanide solution would be applied to the leach heaps using a drip irrigation system. Typically lime and caustic are used to maintain the cyanide at a high pH in solution and to minimize the formation of hydrogen cyanide (HCN). With the continued pH control of the process solution, HCN formation and the off-gas of HCN would be negligible; consequently, ambient HCN concentrations and resultant odors would be minimal.

Sources of fugitive dust and other pollutants include:

- Drilling and blasting
- Loading haul trucks
- Hauling ore/waste rock
- Truck dumps
- Primary and secondary crushers
- Conveyors, stackers and screens
- Leach pads
- Tailings impoundment
- Haul road maintenance
- Support vehicles
- Lime silo storage, loading and unloading
- Cement silo storage, loading and unloading
- Crucible furnace and carbon kiln
- Mercury retort
- Storage tanks
- Wind erosion of active and inactive disturbance areas, overburden, and ore stockpiles

Table 3-13 lists the total potential to emit for the various air pollutants from all point sources and fugitive sources at the mine in tons per year.

As part of the Air Quality Permit process, Marigold Mine conducted ambient monitoring for $PM_{10}$ during the time period October 1991 through October 1992. The highest concentrations of $PM_{10}$ were 84 $\mu g/m^3$ for the primary and 96 $\mu g/m^3$ for the collocated sampler recorded on June 11, 1992. These values are well below the 24-hour ambient air quality standard of 150 $\mu g/m^3$. The annual average concentration of $PM_{10}$ was less than 30 $\mu g/m^3$, and this value is well below the annual standard of 50 $\mu g/m^3$.

The State of Nevada has previously granted air quality permits for the existing mine operations. The project would comply with all existing air quality standards in Nevada. In October 1999 GMMC applied for their 5-year air quality permit extension. The mine currently operates under NDEP Air Quality Operating Permit #AP1041-0158.

#### 3.3.2.2 8-South Partial Pit Backfill Alternative

The impacts to air quality under the 8-South Partial Pit Backfill Alternative would be the same as those described in the Proposed Action.

#### 3.3.2.3 No Action Alternative

Under the No Action Alternative, air emission levels would continue at the current levels through 2001. Fugitive emission levels would gradually decrease through the reclamation period.

### 3.3.3 Cumulative Impacts

The predicted maximum annual concentration of particulates at the point of closest public access beyond the mine property boundary would be less than Nevada's annual ambient air standard of 50 $\mu g/m^3$. The total cumulative 24-hour impact would not exceed the Nevada 24-hour ambient air quality standard of 150 $\mu g/m^3$. Other permitted and non-permitted sources of air pollution are included in background concentrations measured and predicted for the Marigold Mine. Cumulative air quality impacts in the vicinity of the mine would be very slight since the particulate concentrations would fall below 5 $\mu g/m^3$ within 1 mile of the facility. The annual and 24-hour contributions from the mine sources would not cause the air quality in the region to degrade below National or State ambient air quality standards.

### 3.3.4 Potential Mitigation and Monitoring

Air quality permits issued by NDEP require the operator to control emissions, including fugitive emissions, from sources at the mine site due to mining activities. GMMC would apply air pollution controls specified by the NDEP to reduce emissions during construction and operation of the mine. The control system for the crushing, screening, and conveying circuit would consist of dust collectors and fogging water sprays. Emissions from storage silos are controlled with filters or baghouses that eliminate approximately 99 percent of the potential emissions. GMMC has implemented "tackification" procedures for dust control (using corn syrup) at the existing tailings facility. Irrigation of reclamation plantings also is occurring using tailings impoundment water. Fugitive dust from all disturbed areas would be controlled using watering, chemical stabilization, or other controls approved by the Nevada Bureau of Air Quality. Therefore, additional mitigation measures and monitoring are not recommended.

### 3.3.5 Residual Adverse Impacts

There would be no residual adverse impacts to air quality from the planned expansion since reclamation would stabilize exposed soil and control fugitive dust emissions. As vegetation becomes established, particulate levels should return to what is typical for a dry desert environment. Once the disturbance ceases and wind erodible surfaces are reclaimed, air resources would return to pre-mining conditions.

# 3.4 Soils

## 3.4.1 Affected Environment

### 3.4.1.1 Detailed Study Area

The soils in the project area have formed in alluvial fan deposits or in colluvium and residuum from mixed rocks on hillslopes and crests. In the upland positions, soils are predominantly shallow and moderately deep over bedrock and are gravelly or cobbly. At higher elevations in the extreme southern part of the project area, cooler seasonal and mean annual soil temperatures prevail relative to the rest of the project area. At lower elevations, very deep gravelly soils occur on alluvial fan piedmonts and fan skirts. Highly sodic soils occur in the upper fan piedmont positions, and slightly to moderately saline soils occur at somewhat lower elevations on fan skirts and inset fans. Information regarding soils located in the project area and vicinity was primarily obtained from the reconnaissance (Order III) soil survey of eastern Humboldt County (Natural Resource Conservation Service [NRCS] 1998 [in progress]), and the detailed (Order II) soil survey conducted for the project area (JBR 1997).

A total of 12 soil mapping units occur in the EIS study area. Of these, nine are units from the detailed survey (JBR 1997), and three are reconnaissance survey units that occur outside the limits of disturbance for the Proposed Action (NRCS 1998 [in progress]). The detailed survey includes a unit that delineates existing and approved disturbance associated with previous projects. The occurrence and extent of soil mapping units is shown in Map 3-10.

The physical characteristics and suitability of the soils for reclamation use are summarized in Tables 3-14 and 3-15. Surface soils within the project area were evaluated for reclamation suitability. Threshold values for a soil's suitability as a growth media for reclamation use were based on the following parameters:

- Sodium adsorption ratio – greater than 46 (excess sodium);
- Electrical conductivity – greater than 16 mmhos/cm (excess salinity);
- pH – greater than 8.5 (high alkalinity);
- Soil texture - textures of clay, silty clay, sandy clay, (high clay content) sand, fine sand, very fine sand (high sand content);
- Coarse fragments – greater than 60 percent by weight (high coarse fragment content); and
- Erosion hazard for water or wind - severe.

Surface soils that exceeded these criteria were considered unsuitable for salvage and reclamation. Unsuitable soils have qualities that limit revegetation success and slope stabilization. If the volume of salvageable surface soil is insufficient for reclamation purposes, suitable alluvial material would be salvaged and stockpiled for reclamation activities.

The Linrose-Roca association (Mapping Unit 1) occurs on higher hillslopes and crests in the extreme southern part of the study area. Slopes range from 20 to 70 percent. The Linrose soil is on north- and east-facing slopes and occupies about 50 percent of the unit. It is moderately deep and well drained. Typically the surface layer is dark grayish brown gravelly loam about 11 inches thick. The subsoil is pale brown very gravelly or extremely gravelly sandy loam about 17 inches thick over fractured chert bedrock. The Roca soil also occupies sideslopes, and makes up about 35 percent of the unit. It is moderately deep and well drained. Typically the surface layer is dark grayish brown gravelly silt loam 4 to 8 inches thick. The subsoil is brown very gravelly clay loam about 20 inches thick over fractured chert bedrock. Included with this mapping unit are about 10 percent Soughe soils and 5 percent Hoot soils, as described below. Based on suitability criteria, this unit has suitable reclamation materials to depths varying

**Table 3-14**
**Soil Materials Suitable for Reclamation[1]**

| Mapping Unit | Soil | Mapping Unit Slope (Percent) | Percent of Unit, by Soil | Suitable Salvage Depth, in. | Limits to Suitability |
|---|---|---|---|---|---|
| 1 | Linrose | 20 to 70 | 50 | 20 | Small Stones, Depth to Rock |
| | Roca | | 35 | 6 | Small Stones, Too Clayey, Depth to Rock |
| | Inclusions | | | | |
| | Soughe | | 10 | 0 | Too Alkaline, Depth to Rock |
| | Hoot | | 5 | 6 | Too Alkaline, Small Stones, Depth to Rock |
| 2 | Soughe | 15 to 50 | 60 | 0 | Too Alkaline, Depth to Rock |
| | Hoot | | 25 | 6 | Too Alkaline, Small Stones, Depth to Rock |
| | Inclusions | | | | |
| | Burrita | | 5 | 10 | Small Stones, Too Clayey, Depth to Rock |
| | Panlee | | 5 | 30 | Too Alkaline, Small Stones |
| | R. O. | | 5 | 0 | Depth to Rock |
| 3 | Soughe | 15 to 50 | 85 | 0 | Too Alkaline, Depth to Rock |
| | Inclusions | | | | |
| | Hoot | | 10 | 6 | Too Alkaline, Small Stones, Depth to Rock |
| | R. O. | | 5 | 0 | Depth to Rock |
| 4[2] | Rose Cr | 2 to 8 | 90 | 60 | Possibly Too Alkaline in Upper 10" |
| | Inclusions | | | | |
| | Oxcorel | | 10 | 6 | Excess Sodium, Too Clayey |
| 5[2] | Oxcorel | 2 to 8 | 90 | 6 | Excess Sodium, Too Clayey |
| | Inclusions | | | | |
| | Alluvium | | 10 | 0 | Too Sandy, Small Stones |
| 6 | Hoot | 20 to 50 | 45 | 6 | Too Alkaline, Small Stones, Depth to Rock |
| | Burrita | | 40 | 10 | Small Stones, Too Clayey, Depth to Rock |
| | Inclusions | | | | |
| | Soughe | | 5 | 0 | Too Alkaline, Depth to Rock |
| | Panlee | | 5 | 15 | Too Alkaline, Small Stones |
| | R. O. | | 5 | 0 | Depth to Rock |

Table 3-14 (Continued)

| Mapping Unit | Soil | Mapping Unit Slope (Percent) | Percent of Unit, by Soil | Suitable Salvage Depth, in. | Limits to Suitability |
|---|---|---|---|---|---|
| 7 | Soughe | 15 to 50 | 55 | 0 | Too Alkaline, Depth to Rock |
| | Burrita | | 30 | 10 | Small Stones, Too Clayey, Depth to Rock |
| | Inclusions | | | | |
| | Hoot | | 10 | 6 | Too Alkaline, Small Stones, Depth to Rock |
| | R. O. | | 5 | 0 | Depth to Rock |
| 8[2] | Whirlo | 0 to 2 | 85 | 36 | Too Alkaline, Small Stones |
| | Inclusions | | | | |
| | Alluvium | | 10 | 0 | Too Sandy, Small Stones |
| | Oxcorel | | 5 | 6 | Excess Sodium, Too Clayey |
| EX | Existing Disturbance, Misc. Roads & Linear Features | | | 0 | |

[1]Approximately 15 percent inclusions (soils other than the major components) occur in each unit.
[2]Mapping units 4, 5, and 8 overlie deep alluvial matrial that is probably suitable for salvage between depths of 10 to 50 feet (Zielinski 1999).

**Table 3-15**
**Soil Characteristics and Reclamation Suitabilities [1]**

| Soil Series/Soil Mapping Unit Name [1] | Associated Mapping Unit(s) [1] | Dominant Associated Vegetation [1] | Surface Texture [1] | Suitable Soil Depth (in.) | Soil Limitations for Use as Growth Media | Susceptibility to Erosion [1] |
|---|---|---|---|---|---|---|
| Burrita | 6, 7 | Big sagebrush, rabbitbrush, bottlebrush squirreltail | Very gravelly fine sandy loam | 10 | Small stones, too clayey, depth to rock | Water: Slight<br>Wind: Slight |
| EX[2] | EX | N/A | N/A | N/A | N/A | N/A |
| Hoot | 2, 6 | Shadscale, bud sagebrush, bottlebrush squirreltail | Very gravelly loam | 6 | Too alkaline, small stones, depth to rock | Water: Moderate<br>Wind: Slight |
| Linrose | 1 | Black sagebrush, rabbitbrush, bottlebrush squirreltail, bluebunch wheatgrass | Loam | 20 | Small stones, depth to rock | Water: Severe<br>Wind: Slight |
| Oxcorel | 5 | Shadscale, bud sagebrush, bottlebrush squirreltail | Gravelly clay loam | 6 | Excess sodium, too clayey | Water: Slight<br>Wind: Moderate |
| Roca | 1 | Black sagebrush, rabbitbrush, bottlebrush squirreltail, bluebunch wheatgrass | Silt loam | 6 | Small stones, too clayey, depth to rock | Water: Moderate<br>Wind: Slight |
| Rose Creek | 4 | Basin wildrye, big sagebrush, greasewood, rabbitbrush, cheatgrass | Fine sandy loam | 60 [1] | Possibly too alkaline in upper 10 inches | Water: Slight<br>Wind: Slight |
| Soughe | 2, 3, 7 | Shadscale, big sagebrush, bottlebrush squirreltail | Gravelly sandy clay loam | 0 | Too alkaline, depth to rock | Water: Slight<br>Wind: Slight |
| Whirlo | 8 | Shadscale, big sagebrush, cheatgrass | Gravelly fine sandy loam | 10 | Too alkaline, small stones | Water: Slight<br>Wind: Slight |

[1] Source: JBR Environmental Consultants, Inc. 1998.
[2] EX = Existing disturbance.

LEGEND

PROPOSED FACILITIES

PRIVATE LAND/PUBLIC LAND CLAIM BOUNDARY

EXISTING PERMIT BOUNDARY

PROPOSED PERMIT BOUNDARY

SOIL TYPES

1 - Linrose-Roca Association

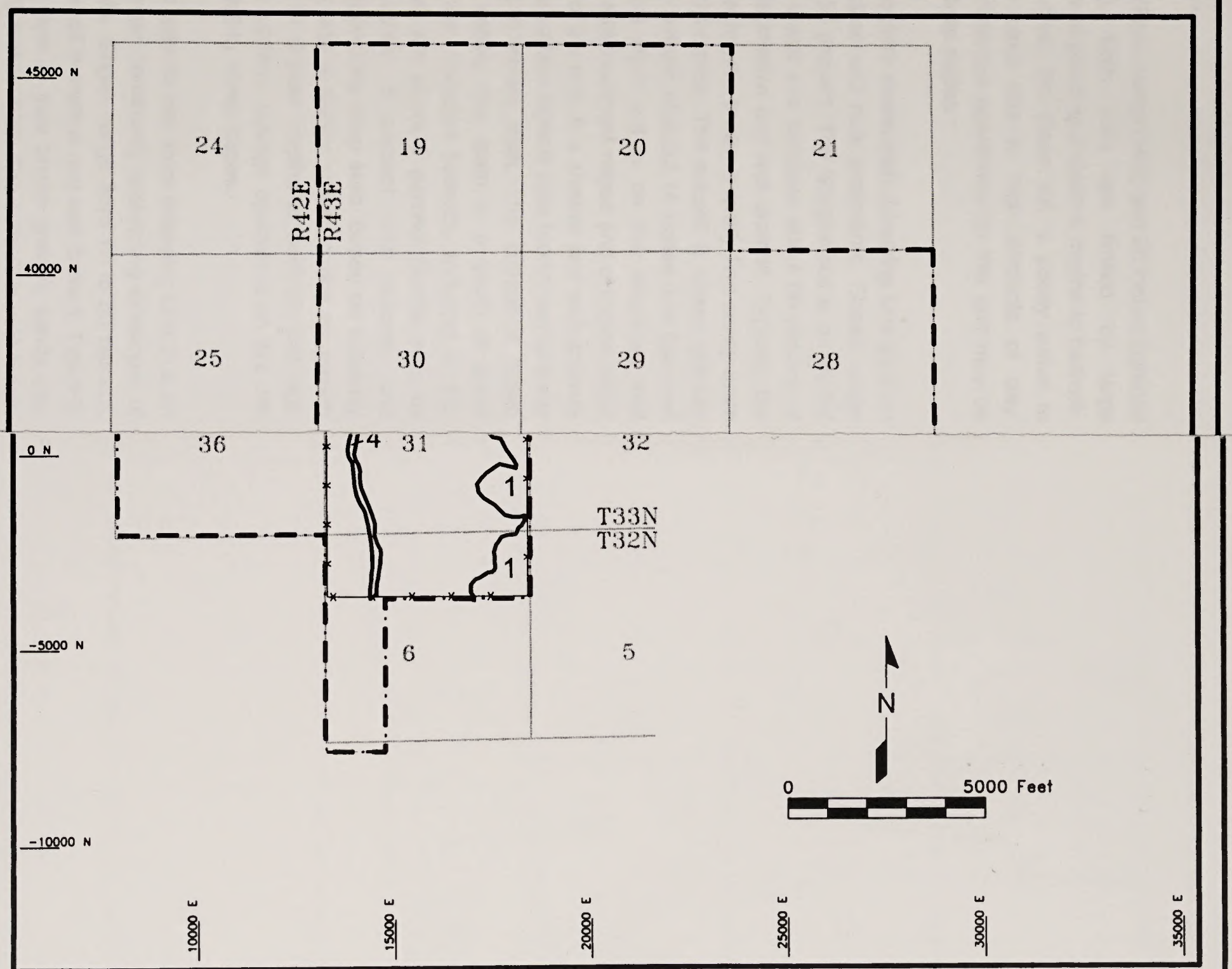
2 - Soughe-Hoot Association

3 - Soughe gravelly clay loam, 15 to 50 percent slopes

4 - Rose Creek sandy loam, 2 to 8 percent slopes

5 - Oxcorel clay loam, 2 to 8 percent slopes

Source: JBR Environmental Consultants 1997




Map 3-10

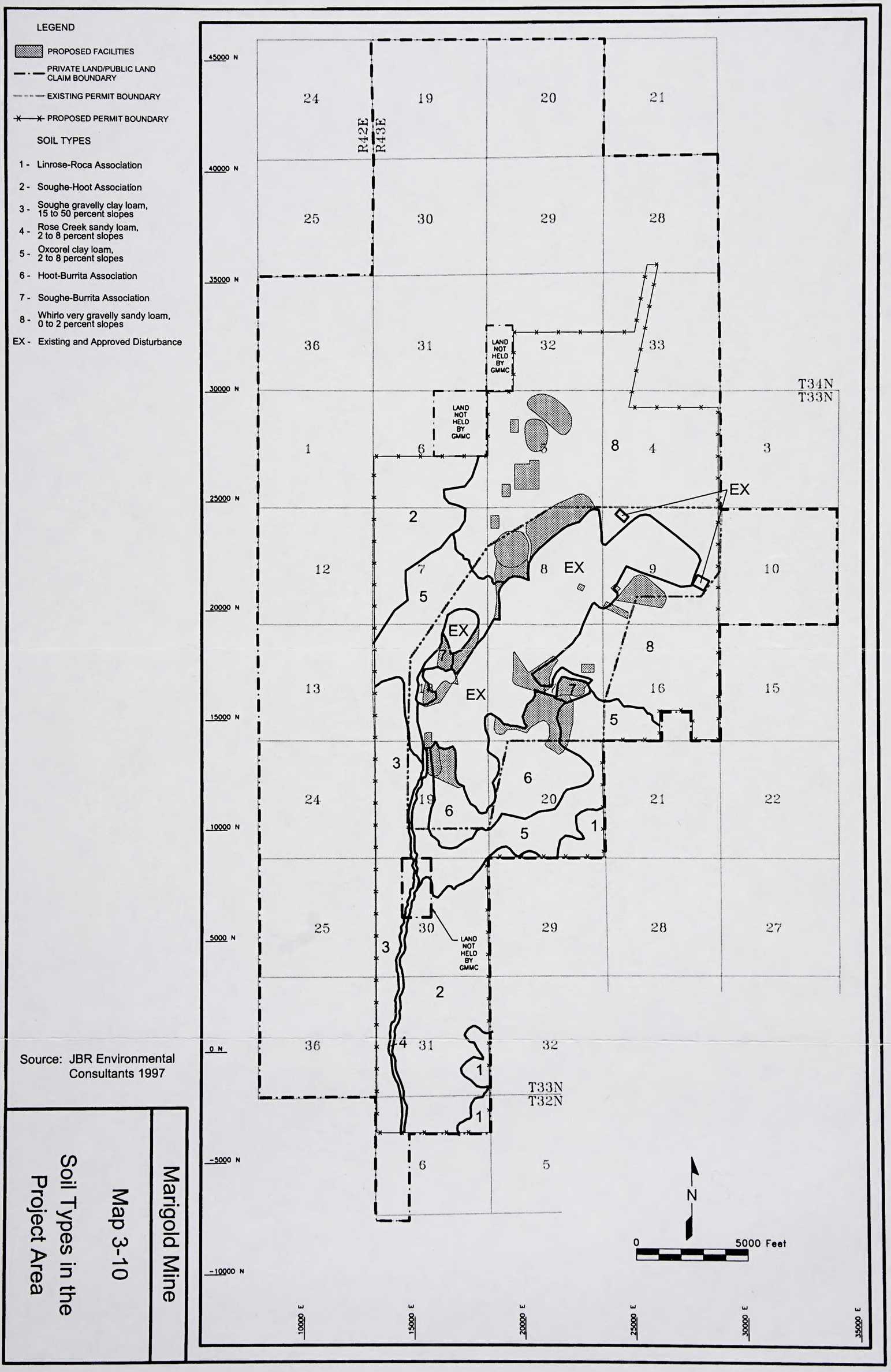
Soil Types in the Project Area

Marigold Mine

**Table 3-15**
**Soil Characteristics and Reclamation Suitabilities [1]**

| Soil Series/Soil Mapping Unit Name [1] | Associated Mapping Unit(s) [1] | Dominant Associated Vegetation [1] | Surface Texture [1] | Suitable Soil Depth (in.) | Soil Limitations for Use as Growth Media | Susceptibility to Erosion [1] |
|---|---|---|---|---|---|---|
| Burrita | 6, 7 | Big sagebrush, rabbitbrush, bottlebrush squirreltail | Very gravelly fine sandy loam | 10 | Small stones, too clayey, depth to rock | Water: Slight<br>Wind: Slight |
| EX[2] | EX | N/A | N/A | N/A | N/A | N/A |
| Hoot | 2, 6 | Shadscale, bud sagebrush, bottlebrush squirreltail | Very gravelly loam | 6 | Too alkaline, small stones, depth to rock | Water: Moderate<br>Wind: Slight |
| Linrose | 1 | Black sagebrush, rabbitbrush, bottlebrush squirreltail, bluebunch wheatgrass | Loam | 20 | Small stones, depth to rock | Water: Severe<br>Wind: Slight |
| Oxcorel | 5 | Shadscale, bud sagebrush, bottlebrush squirreltail | Gravelly clay loam | 6 | Excess sodium, too clayey | Water: Slight<br>Wind: Moderate |
| Roca | 1 | Black sagebrush, rabbitbrush, bottlebrush squirreltail, bluebunch wheatgrass | Silt loam | 6 | Small stones, too clayey, depth to rock | Water: Moderate<br>Wind: Slight |
| Rose Creek | 4 | Basin wildrye, big sagebrush, greasewood, rabbitbrush, cheatgrass | Fine sandy loam | 60 [1] | Possibly too alkaline in upper 10 inches | Water: Slight<br>Wind: Slight |
| Soughe | 2, 3, 7 | Shadscale, big sagebrush, bottlebrush squirreltail | Gravelly sandy clay loam | 0 | Too alkaline, depth to rock | Water: Slight<br>Wind: Slight |
| Whirlo | 8 | Shadscale, big sagebrush, cheatgrass | Gravelly fine sandy loam | 10 | Too alkaline, small stones | Water: Slight<br>Wind: Slight |

[1] Source: JBR Environmental Consultants, Inc. 1998.
[2] EX = Existing disturbance.




Source: JBR Environmental Consultants 1997

Marigold Mine

Map 3-10
Soil Types in the Project Area



between 6 (Roca component) and 20 inches (Linrose component). Both soils are limited by large percentages of gravel and shallow depths to bedrock. Below 6 inches, the Roca soil is poorly suited to reclamation uses due to high amounts of clay. Conducting salvage operations on this unit may be limited by steep slopes.

The Soughe-Hoot association (Mapping Unit 2) is on lower hillslopes and rock pediments. Slopes range from 15 to 50 percent. The Soughe soil is on foothill slopes and crests and occupies about 60 percent of the unit. It is shallow and well drained. Typically the surface layer is pale brown gravelly fine sandy loam about 5 inches thick. The subsoil is brown gravelly clay loam to a depth of about 14 inches over fractured bedrock. The Hoot soil is on the shoulders and summits of rock pediment ridges and occupies about 25 percent of the unit. It is shallow and well drained. Typically the surface layer is pale brown very gravelly loam about 6 inches thick. The subsoil is brown gravelly or cobbly clay loam to a depth of about 15 inches over fractured bedrock. Included in this mapping unit are about 5 percent Burrita soils as described below, 5 percent rock outcrop, and 5 percent moderately deep soils. Based on suitability criteria, this unit is poorly suited to use as growth media due to shallow depths to bedrock and high alkalinity. In addition, salvage operations on this unit may be limited by steep slopes.

The Soughe gravelly clay loam (Mapping Unit 3) is on the summits and dominantly east-facing sideslopes of lower foothills. Slopes range from 15 to 50 percent. The Soughe soil is shallow and well drained. Typically the surface layer is pale brown gravelly sandy clay loam about 3 inches thick. The subsoil is pale brown extremely gravelly sandy clay loam about 10 inches thick over fractured bedrock. Approximately 85 percent of the unit consists of Soughe gravelly clay loam. Included in this unit are about 10 percent Hoot very gravelly sandy clay loam soils similar to those described above and 5 percent rock outcrop. Based on suitability criteria, this unit is poorly suited to use as growth media due to shallow depths to bedrock and high alkalinity. In addition, salvage operations on this unit may be limited by steep slopes.

The Rose Creek sandy loam (Mapping Unit 4) formed in narrow alluvial deposits along the Trout Creek drainage. Slopes are 2 to 8 percent. The Rose Creek soil is very deep and poorly drained. Typically the surface layer is gray fine sandy loam or silt loam about 10 inches thick. The subsoil is grayish brown sandy loam to a depth of 40 inches or more over variegated very gravelly sand. Included in this mapping unit are about 10 percent Oxcorel soils, as described below. Based on suitability criteria, this unit is suitable from depths of 10 to 60 inches or more for use as growth media. The uppermost 10 inches of the soil are poorly suited to reclamation uses due to alkalinity, but if significantly deeper materials are salvaged this may be overcome by blending during salvage and regrading operations. This unit overlies deep alluvium, which may be suitable for salvage and re-use as growth medium. Areas containing highly alkaline materials to much greater depths may occur within the map delineations and should be avoided in salvage operations, if possible. In addition, this unit occurs in a narrow configuration, which may limit the ability of heavy equipment to salvage it effectively.

The Oxcorel clay loam (Mapping Unit 5) formed in alluvium on fan piedmonts. Slopes are 2 to 8 percent. The Oxcorel soil is very deep and well drained. Typically the surface layer is pale brown gravelly sandy loam about 5 inches thick. The subsoil is dark yellowish brown extremely gravelly clay loam about 30 inches thick overlying a light yellowish brown very gravelly sandy loam to a depth of 50 inches or more. The Oxcorel soil is strongly sodium-affected below a depth of about 5 inches. Included with this soil in mapping are 10 percent recent alluvial deposits along stream channels. Based on suitability criteria, this Oxcorel mapping unit is suitable to a depth of about 6 inches for use in a reclamation program. Below this depth, the near-surface soil materials are highly alkaline and poorly suited to use as growth media. This unit overlies deep alluvium, which may be suitable for salvage and re-use as growth medium.

The Hoot-Burrita association (Mapping Unit 6) occurs on foothill sideslopes. Slopes range from 2 to 50 percent. The Hoot soil is on the shoulders and summits of rock pediment ridges and occupies about 45 percent of the unit. It is shallow and well drained. Typically the surface layer is pale brown very gravelly loam about 6 inches thick. The subsoil is brown gravelly or cobbly clay loam to a depth of about 15 inches over fractured bedrock. The Burrita soil occupies sideslopes and is shallow and well drained. It occupies about 40 percent of the unit. Typically the surface layer is pale brown very gravelly fine sandy loam about 4 inches thick. The subsoil is light yellowish brown extremely gravelly clay loam to a depth of about 11 inches over fractured bedrock. Included in this mapping unit are about 5 percent Soughe soils as described above, 5 percent rock outcrop, and 5 percent moderately deep soils. Based on suitability criteria, this unit is suitable for use as a growth media to depths ranging between 4 inches (Hoot component) and 10 inches (Burrita component). Below these depths, alkalinity, large percentages of gravel, and shallow depths to bedrock limit the use of the soils as reclamation growth media. In addition, salvage operations on this unit may be limited by steep slopes.

The Soughe-Burrita association (Mapping Unit 7) is on foothill sideslopes and summits. Slopes range from 15 to 50 percent. The Soughe soil is on foothill crests and sideslopes and occupies about 55 percent of the unit. It is shallow and well drained. Typically the surface layer is pale brown gravelly sandy clay loam about 3 inches thick. The subsoil is pale brown extremely gravelly clay loam about 10 inches thick over fractured bedrock. The Burrita soil occupies sideslopes and is shallow and well drained. It occupies about 40 percent of the unit. Typically the surface layer is pale brown very gravelly fine sandy loam about 4 inches thick. The subsoil is light yellowish brown extremely gravelly clay loam to a depth of about 11 inches over fractured bedrock. Included with this unit in mapping are about 10 percent Hoot soils as described above and about 5 percent rock outcrop. Based on suitability criteria, this unit is suitable for use as growth media to depths ranging between 0 inch (Soughe component) and 10 inches (Burrita component). Below these depths, alkalinity, shallow depths to bedrock, and large percentages of gravel or clay limit the use of the soils as reclamation growth media. In addition, salvage operations on this unit may be limited by steep slopes.

The Whirlo very gravelly sandy loam (Mapping Unit 8) occurs on alluvial fan remnants on slopes that are nearly level to approximately 2 percent. It occupies about 85 percent of the mapping unit. The Whirlo soil is very deep and well drained. Typically the surface layer is pale brown gravelly fine sandy loam about 7 inches thick. The subsoil is pale brown very gravelly sandy loam about 30 inches thick over a light yellowish brown extremely gravelly loam sand to a depth of 60 inches or more. Included with this soil in mapping are 10 percent recent alluvial deposits along stream channels and 5 percent Oxcorel very gravelly clay loam. Based on suitability criteria, this unit is suitable for use as growth media to a depth of about 36 inches. Below this depth, highly alkaline layers and large percentages of gravel limit the suitability of the near-surface soil materials for use as a reclamation growth media. This unit overlies deep alluvial deposits, which also may be suitable for salvage and re-use as growth medium.

Mapping unit EX consists of existing and approved disturbance in the central part of the detailed survey area. Features include existing pits, process facilities, stockpiles, and waste rock dumps. In general, no salvageable native soil materials occur in these areas.

#### 3.4.1.2 General Study Area

The soils in the general study area are similar to those described for the project area. Soils on foothill sideslopes are generally shallow or moderately deep over bedrock. Cooler mean annual soil temperatures occur at higher mountain elevations. Deeper soils occur in the depositional environments at toeslopes and on alluvial fans. Many of the soils throughout the region contain salt accumulations and large

percentages of gravel. Gravel content generally decreases in the down-valley direction, with soils transitioning from sands to clays as distance increases from the mountain fronts.

### 3.4.2 Environmental Consequences

The primary soils issues for the Proposed Action and project alternatives are the suitability of available resources for use as growth media, and the potential for increased erosion and sedimentation. Direct and indirect effects to soils can occur as a result of the project, primarily from excavation and fill activities or from vegetation removal. The latter may expose the underlying soils to the erosive forces of wind and water, increasing the potential for accelerated erosion. Potential impacts to soil resources could occur from accelerated erosion as a result of vegetation removal and soil disturbance during project construction, operation, and the early phases of the reclamation program. Potential impacts to soils also include the loss of microbial populations, less desirable soil structure, and less desirable drainage characteristics and available water capacity for plant growth.

#### 3.4.2.1 Proposed Action

The Proposed Action would disturb approximately 717 acres. Of this, approximately 59 acres involve disturbances such as growth media stockpile placement or construction of diversion ditches, which likely would not involve growth media salvage. An additional 55 acres involve existing disturbance from which available growth media has already been salvaged where it occurred during previously approved activities, or where variable amounts of disturbed materials exist that may be suitable for growth media use. Approximately 5 acres would be disturbed from ongoing exploration activities, the location of which has not been precisely determined. The remaining 598 acres are comprised of native soils, which have varying degrees of suitability for use as growth media.

Table 3-16 indicates the acreages of soil mapping units that occur on areas that would be disturbed under the Proposed Action. Salvage suitability and erosion hazards are indicated on Map 3-11. The volumes of suitable growth media that are potentially salvageable from the proposed disturbance areas are shown in Table 3-17. These estimates represent a maximum volume based on accepted growth media criteria for materials having moderate suitability or better (Soil Conservation Service 1983; JBR 1997a). Estimates do not account for limits on salvage operations based on the types of equipment used or local land surface conditions. Even without accounting for such factors, 10 to 20 percent less volume may be expected due to on-site soil variability and handling losses.

Table 3-17 indicates that approximately 1.7 million cubic yards of material may be suitable for salvage on the 598 acres of native soils that occur in the proposed project area. The actual amount that could reasonably be salvaged is somewhat less than this, due to the limitations of heavy equipment operating on steep slopes and losses in material transport. Assuming that 85 percent of the suitable volume is actually recoverable in salvage operations approximately 1.45 million cubic yards of material would be available for use as growth media during reclamation activities.

Approximately 717 acres of new disturbance would occur from the Proposed Action. Of this, approximately 131 acres are associated with new pit disturbance. Growth media may be replaced on approximately 70 acres of pit floors and ramps, and approximately 61 acres of pit areas would not receive growth media. Thus, approximately 656 acres of new disturbance would undergo growth media replacement. The available growth media volume (see Table 3-17) indicates that an average depth of approximately 20 inches of growth media from native soil resources could be restored on the ***656*** acres to be revegetated. With losses from salvage and transport resulting in 1.45 million cubic yards of available growth media, approximately

**Table 3-16**
**Native Soil Occurrence in Proposed Disturbance Areas**

| Mine Component | Soil Mapping Unit Extent (acres)[1] | | | | | Total |
|---|---|---|---|---|---|---|
| | 4 | 5 | 6 | 7 | 8 | |
| 5-North Pit | | | | | 29.4 | 29.4 |
| 8-North Pit | | | | | 49.0 | 49.0 |
| Red Rock Pit Expansion | 1.0 | 5.7 | 12.2 | | | 18.9 |
| Top Zone Pit Expansion | | | 29.0 | | | 29.0 |
| 5-North Waste Rock Dump | | | | | 54.6 | 54.6 |
| 8-North Waste Rock Dump | | | | | 85.4 | 85.4 |
| Resort Waste Rock Dump Expansion | | 25.2 | 74.2 | 4.0 | | 103.4 |
| Old Marigold Waste Rock Dump Expansion | | 23.3 | | 17.7 | | 41.0 |
| 5-North Heap Leach Pad | | | | | 30.9 | 30.9 |
| SW Heap Leach Pad expansion | | | 0.2 | | 15.7 | 15.9 |
| Process Pond | | | | | 1.6 | 1.6 |
| Process Pond | | | | | 1.2 | 1.2 |
| Tailings Impoundment | | | | | 49.2 | 49.2 |
| Infill Area near 8-North Pit | | | 7.3 | | 22.4 | 29.7 |
| Infill Area near Old Marigold Pit | | | | 8.7 | | 8.7 |
| Infill Area east of Southwest Heap Leach expansion | | | | 21.7 | | 21.7 |
| 5-North Haul Road | | | | | 28.0 | 28.0 |
| Total | | | | | | 597.6 |

[1]Soil Mapping Units 1, 2, and 3 do not occur in areas proposed for disturbance.

16 inches could be restored on average. These figures could vary somewhat depending on actual growth media salvage and replacement locations.

The majority of material is available from Soil Mapping Unit 8, Whirlo very gravelly sandy loam, with the next dominant source being Soil Mapping Unit 6, Hoot-Burrita Association. These materials would be gravelly and possibly alkaline, as would much of the other material available on the site (see Table 3-15). In combination with deeper alluvial materials, there should be sufficient growth media of suitable quality to provide for the successful growth and establishment of adapted plant species in the reclamation program.

Given that there are substantial volumes of available growth media, a deeper replacement depth (12 to 18 inches) should be restored to the tailings surface to ensure the stabilization and revegetation of that site. In addition, the uppermost 1 or 2 inches of native soils could be avoided or not salvaged during clearing and grubbing activities to reduce the introduction of annual weed seeds on reclaimed surfaces. Sufficient volumes of suitable materials would still remain.

As shown in Table 3-15, a range of wind and water erodibility hazards exists on the site (JBR 1997a). The majority of salvageable growth media have slight susceptibility to erosion from water or wind.

LEGEND

PROPOSED FACILITIES

PRIVATE LAND/PUBLIC LAND CLAIM BOUNDARY

EXISTING PERMIT BOUNDARY

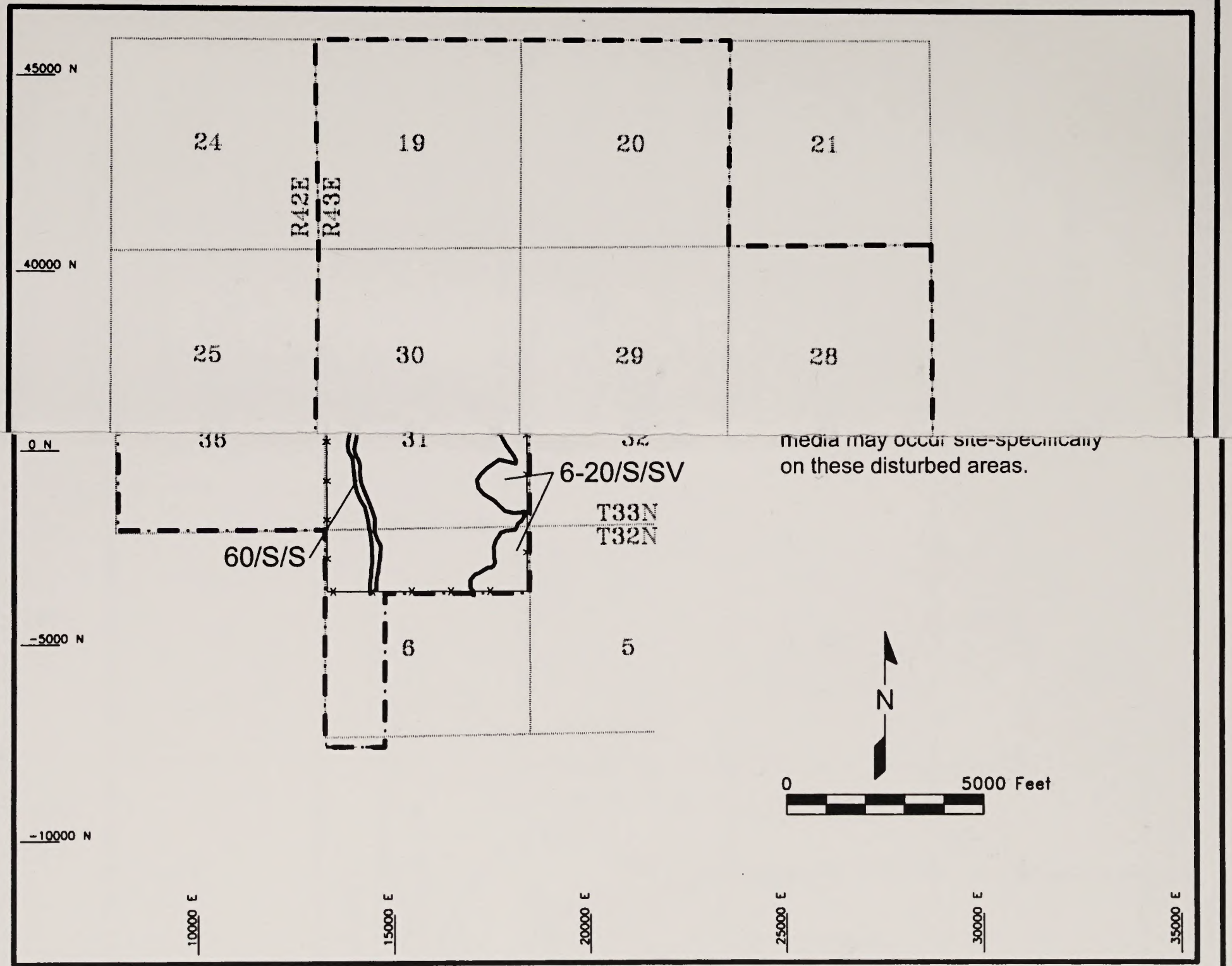
PROPOSED PERMIT BOUNDARY

RANGE OF SALVAGEABLE DEPTH, INCHES, FOR DOMINANT SOILS

WIND EROSION HAZARD
S = SLIGHT
M = MODERATE
SV = SEVERE

6-20/S/SV

Source: JBR Environmental Consultants 1997




media may occur site-specifically on these disturbed areas.

Marigold Mine

Map 3-11

Salvageable Soil Characteristics

**Table 3-16**
**Native Soil Occurrence in Proposed Disturbance Areas**

| Mine Component | Soil Mapping Unit Extent (acres)[1] | | | | | Total |
|---|---|---|---|---|---|---|
| | 4 | 5 | 6 | 7 | 8 | |
| 5-North Pit | | | | | 29.4 | 29.4 |
| 8-North Pit | | | | | 49.0 | 49.0 |
| Red Rock Pit Expansion | 1.0 | 5.7 | 12.2 | | | 18.9 |
| Top Zone Pit Expansion | | | 29.0 | | | 29.0 |
| 5-North Waste Rock Dump | | | | | 54.6 | 54.6 |
| 8-North Waste Rock Dump | | | | | 85.4 | 85.4 |
| Resort Waste Rock Dump Expansion | | 25.2 | 74.2 | 4.0 | | 103.4 |
| Old Marigold Waste Rock Dump Expansion | | 23.3 | | 17.7 | | 41.0 |
| 5-North Heap Leach Pad | | | | | 30.9 | 30.9 |
| SW Heap Leach Pad expansion | | | 0.2 | | 15.7 | 15.9 |
| Process Pond | | | | | 1.6 | 1.6 |
| Process Pond | | | | | 1.2 | 1.2 |
| Tailings Impoundment | | | | | 49.2 | 49.2 |
| Infill Area near 8-North Pit | | | 7.3 | | 22.4 | 29.7 |
| Infill Area near Old Marigold Pit | | | | 8.7 | | 8.7 |
| Infill Area east of Southwest Heap Leach expansion | | | | 21.7 | | 21.7 |
| 5-North Haul Road | | | | | 28.0 | 28.0 |
| Total | | | | | | 597.6 |

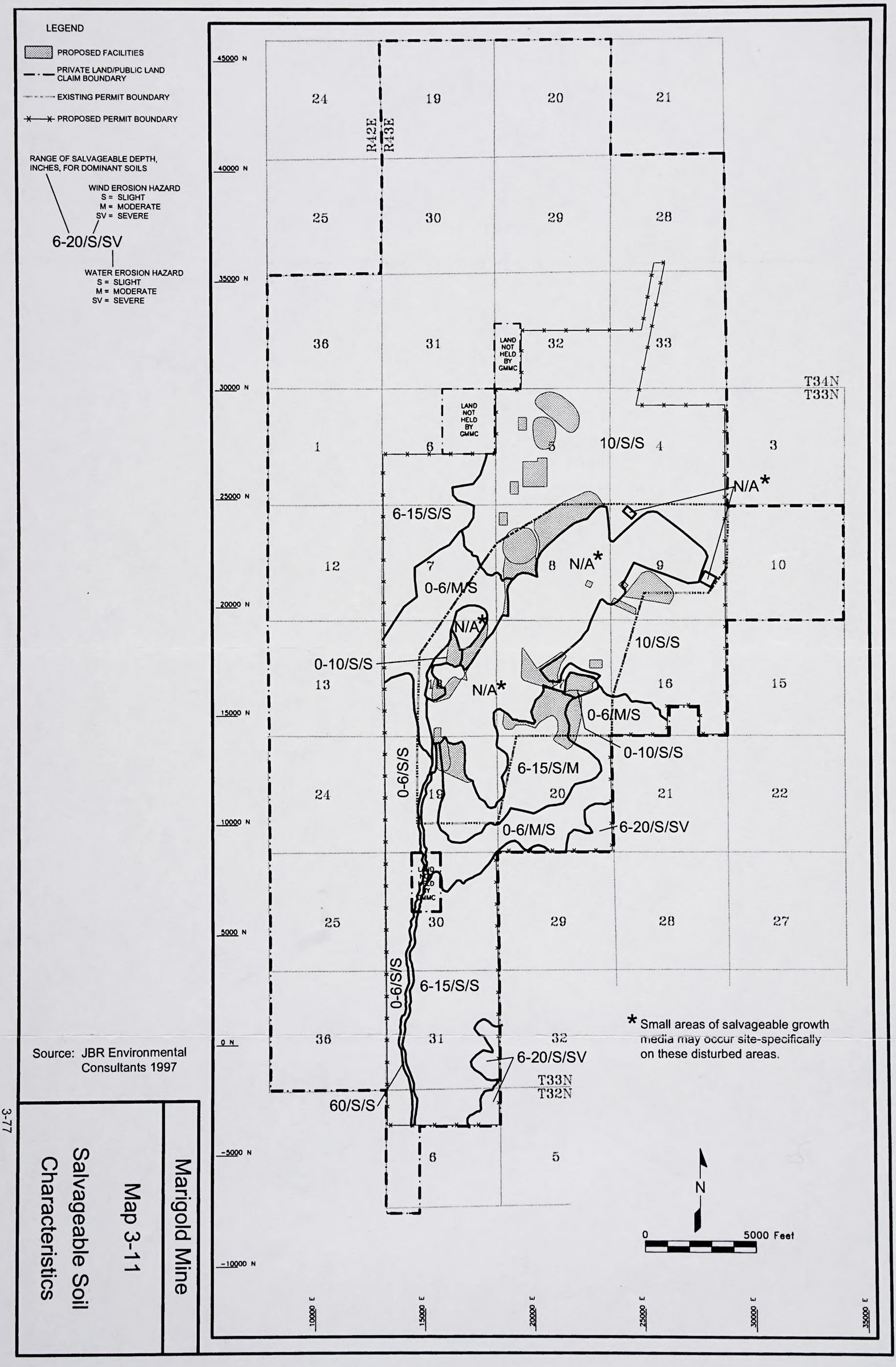
[1]Soil Mapping Units 1, 2, and 3 do not occur in areas proposed for disturbance.

16 inches could be restored on average. These figures could vary somewhat depending on actual growth media salvage and replacement locations.

The majority of material is available from Soil Mapping Unit 8, Whirlo very gravelly sandy loam, with the next dominant source being Soil Mapping Unit 6, Hoot-Burrita Association. These materials would be gravelly and possibly alkaline, as would much of the other material available on the site (see Table 3-15). In combination with deeper alluvial materials, there should be sufficient growth media of suitable quality to provide for the successful growth and establishment of adapted plant species in the reclamation program.

Given that there are substantial volumes of available growth media, a deeper replacement depth (12 to 18 inches) should be restored to the tailings surface to ensure the stabilization and revegetation of that site. In addition, the uppermost 1 or 2 inches of native soils could be avoided or not salvaged during clearing and grubbing activities to reduce the introduction of annual weed seeds on reclaimed surfaces. Sufficient volumes of suitable materials would still remain.

As shown in Table 3-15, a range of wind and water erodibility hazards exists on the site (JBR 1997a). The majority of salvageable growth media have slight susceptibility to erosion from water or wind.


LEGEND
PROPOSED FACILITIES
PRIVATE LAND/PUBLIC LAND CLAIM BOUNDARY
EXISTING PERMIT BOUNDARY
PROPOSED PERMIT BOUNDARY
RANGE OF SALVAGEABLE DEPTH, INCHES, FOR DOMINANT SOILS
WIND EROSION HAZARD
S = SLIGHT
M = MODERATE
SV = SEVERE
6-20/S/SV
WATER EROSION HAZARD
S = SLIGHT
M = MODERATE
SV = SEVERE
R42E
R43E
T34N
T33N
T33N
T32N
LAND NOT HELD BY GMMC
10/S/S
N/A*
6-15/S/S
0-6/M/S
0-10/S/S
6-15/S/M
0-6/S/S
6-20/S/SV
60/S/S
* Small areas of salvageable growth media may occur site-specifically on these disturbed areas.
N
0
5000 Feet
Source: JBR Environmental Consultants 1997
Marigold Mine
Map 3-11
Salvageable Soil Characteristics

LEGEND

PROPOSED FACILITIES

PRIVATE LAND/PUBLIC LAND CLAIM BOUNDARY

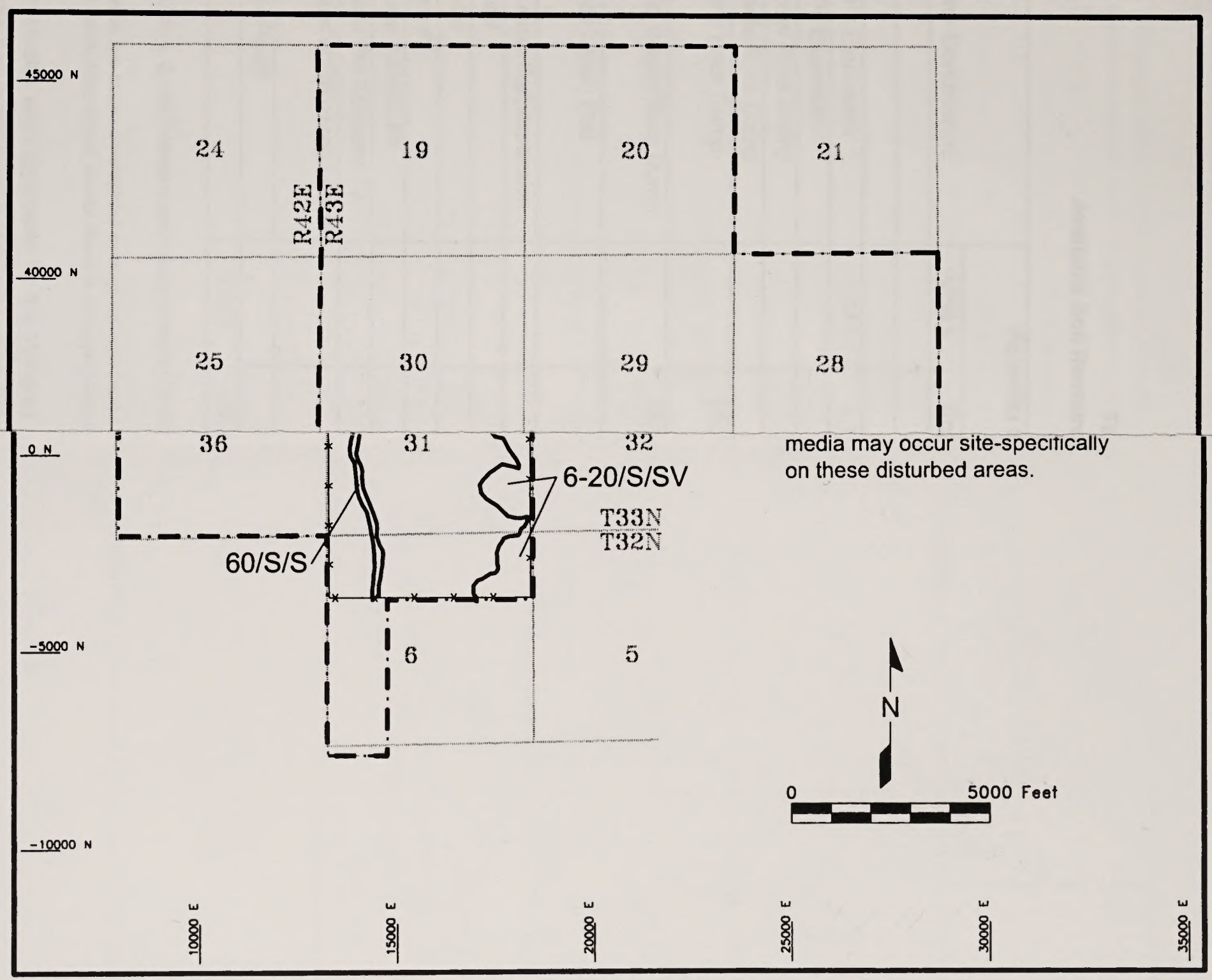
EXISTING PERMIT BOUNDARY

PROPOSED PERMIT BOUNDARY

RANGE OF SALVAGEABLE DEPTH, INCHES, FOR DOMINANT SOILS

WIND EROSION HAZARD
S = SLIGHT
M = MODERATE
SV = SEVERE

6-20/S/SV



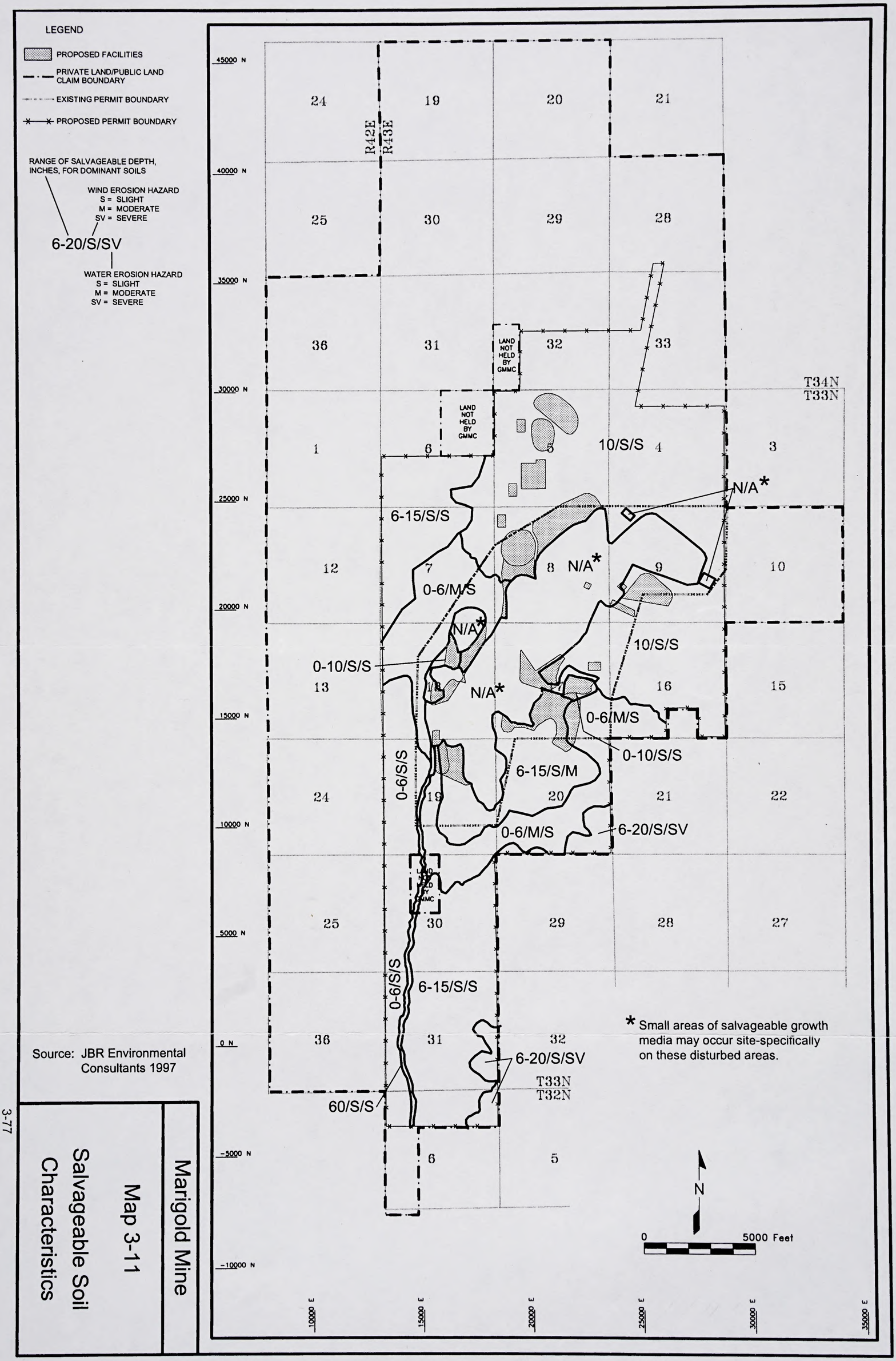

media may occur site-specifically on these disturbed areas.

Source: JBR Environmental Consultants 1997

Marigold Mine

Map 3-11

Salvageable Soil Characteristics




Source: JBR Environmental Consultants 1997

Marigold Mine

Map 3-11

Salvageable Soil Characteristics



**Table 3-17**
**Available Soil Resources for Use as Growth Media**

| Mine Component | Potential Soil Salvage Volume per Soil Type (bank cubic yards)[1] | | | | | Total |
|---|---|---|---|---|---|---|
| | Unit 4 | Unit 5 | Unit 6 | Unit 7 | Unit 8 | |
| 5-North Pit | | | | | 122,137 | 122,137 |
| 8-North Pit | | | | | 203,562 | 203,562 |
| Red Rock Pit Expansion | 7,341 | 4,160 | 12,219 | | | 23,720 |
| Top Zone Pit Expansion | | | 29,046 | | | 29,046 |
| 5-North Waste Rock Dump | | | | | 226,827 | 226,827 |
| 8-North Waste Rock Dump | | | | | 354,780 | 354,780 |
| Resort Waste Rock Dump expansion | | 18,295 | 74,318 | 1,936 | | 94,549 |
| Old Marigold Waste Rock Dump expansion | | 16,916 | | 8,552 | | 25,468 |
| 5-North Heap Leach Pad expansion | | | | | 128,369 | 128,369 |
| SW Heap Leach Pad expansion | | | 200 | | 65,223 | 65,423 |
| Process Pond | | | | | 6,647 | 6,647 |
| Process Pond | | | | | 4,985 | 4,985 |
| Tailings Dam #2 | | | | | 204,393 | 204,393 |
| Infill Area near 8-North Pit | | | 7,312 | | 93,057 | 100,369 |
| Infill Area near Old Marigold Pit | | | | 4,211 | | 4,211 |
| Infill Area east of SW Heap Leach expansion | | | | 10,502 | | 10,502 |
| 5-North Haul Road | | | | | 116,321 | 116,321 |
| Total | 7,341 | 39,371 | 123,095 | 25,201 | 1,526,302 | 1,721,310 |

[1]Soil Mapping Units 1, 2, and 3 do not occur in areas proposed for disturbance.

Note: Volumes are based on weighted average salvage depths from Table 3-15 and acreage figures from Table 3-16. Additional volume is recoverable from deeper alluvial deposits underlying Mapping Units 4, 5, and 8.

Soil erosion studies were conducted for the Marigold growth media and postmining topography using the Revised Universal Soil Loss Equation (RUSLE) (JBR 1996b). These studies utilized appropriate inputs, and indicate that in order to minimize accelerated erosion, the topography should have an actual slope no steeper than 3H:1V; it is essential to contour rip or employ other control practices on of the reclaimed slopes, and a good stand of plant cover should be in place before the contour ripping wears down (generally about 2 to 4 years). If these conditions cannot be met, then additional erosion control practices should be implemented.

The Marigold Mine has conducted intensive (and ongoing) field trials to study growth media and revegetation practices. Revegetation success and bond release has been accomplished in accordance with state and federal revegetation guidelines (Cribley 1996). The Proposed Action includes salvage,

protection, and re-use of suitable plant growth media, in addition to the following proposed measures (JBR 1998):

- Landscaping to create variable, irregular edges and surfaces on reclaimed features;
- Varying slope gradients to reduce energy from surface runoff;
- Direct-hauling topsoil for immediate reclamation use when possible;
- Redistributing soil in patches, particularly on north- and east-facing slopes, to encourage shrub growth and establishment;
- Varying soil depth on reclaimed surfaces to provide vegetation diversity; and
- Dust control measures to reduce soil losses in transport during salvage operations.

Assuming that proposed land stabilization efforts (including revegetation and post-reclamation monitoring) are successful as they have been in the past, there would be little or no accelerated erosion or sedimentation on the site. Soil productivity and physical characteristics would eventually be restored to a functional state as the post-mining ecosystem evolves over time. Based on these evaluations, long-term impacts to soil resources from the Proposed Action are not expected.

#### 3.4.2.2 8-South Partial Pit Backfill Alternative

This alternative would have similar impacts as the Proposed Action, since the types of disturbance would be the same with regard to soil resources. Since less land would be disturbed from the elimination of the 8-North Waste Rock Dump (85 acres), the potential salvage volume would decrease by approximately 101,000 cubic yards (see Table 3-17). This alternative would disturb 85 fewer acres and 2 additional acres would be reclaimed.

The Amended POO indicates that approximately 260,400 cubic yards of growth media exists in current stockpiles (Rayrock Mines, Inc. 1998). If sufficient growth media was salvaged during construction of the 8-South Pit, then the potential growth media replacement would not be significantly affected. This is assumed to be the case, given the occurrence of soils in the 8-South Pit area and the growth media mitigation identified in an earlier Environmental Assessment (BLM 1988). However, if the 8-South Pit backfill would require growth media from the proposed project features, the resulting average replacement depth from the available native soil resources on the new disturbance (without salvage from the 8-North Waste Rock Dump) would then be estimated at 18 inches for the 658 acres to be reclaimed. If there were 15 percent less volume due to salvage and transport losses, then approximately 15 inches of growth media could be applied.

#### 3.4.2.3 No Action Alternative

This alternative would not create any additional impacts to soil resources beyond those activities currently approved. The project area would be reclaimed using the approaches, materials, and standards of existing state and Federal permits and any applicable project stipulations.

### 3.4.3 Cumulative Impacts

The cumulative assessment area for soil resources includes the North Buffalo and Copper Canyon grazing allotments (approximately 203,000 acres) (Map 3-12). Past and present disturbances within the allotments include approximately 12,393 acres that were disturbed during mining and other development activities. This disturbance accounts for approximately 6 percent of the cumulative assessment area. Mine development and operation activities associated with the Proposed Action would result in the disturbance of 717 acres of soils or less than 1 percent of the cumulative assessment area. Reasonably foreseeable future projects identified in the cumulative assessment area would disturb approximately 6,325 acres of soils.

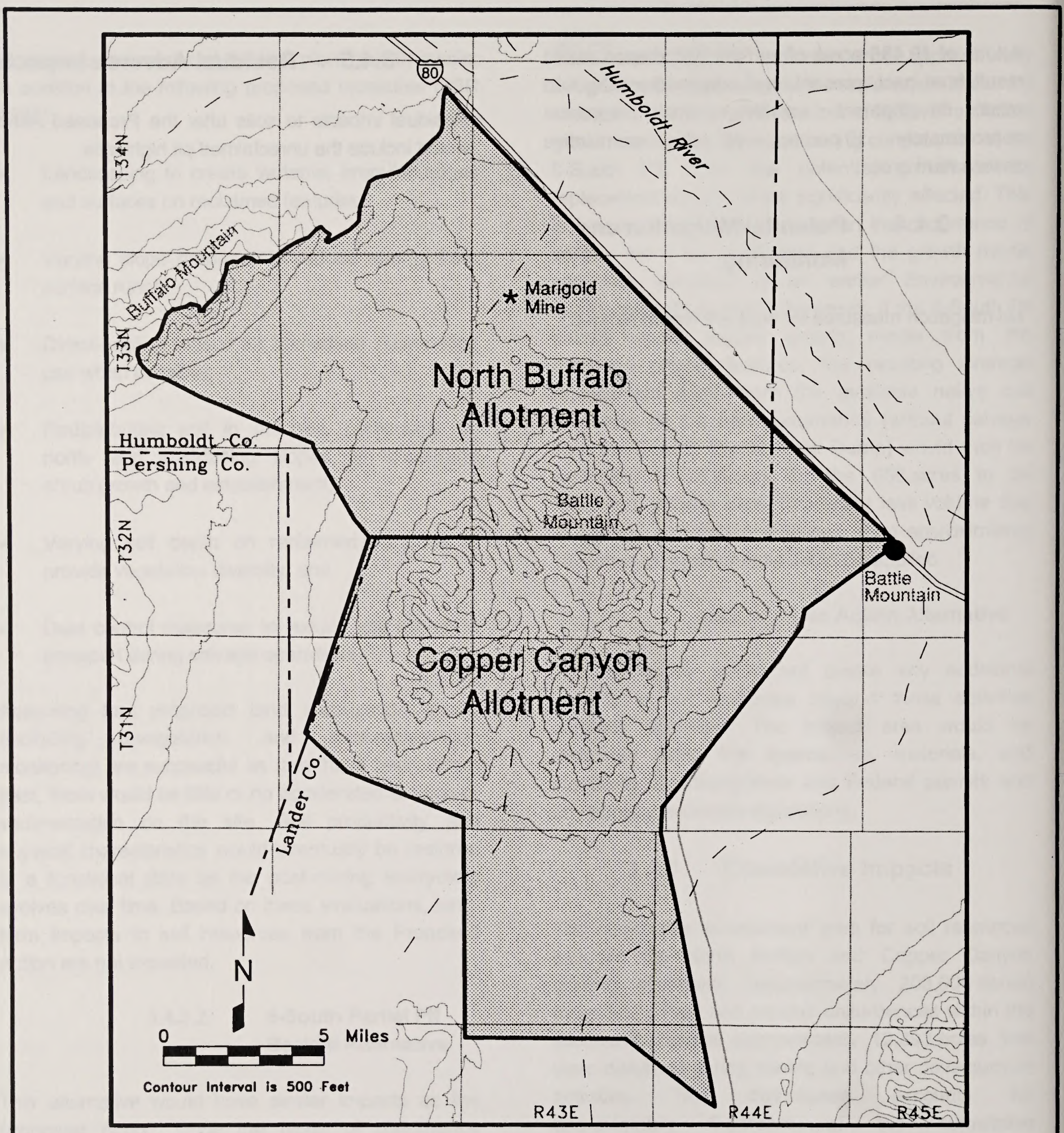
A total of 19,435 acres of surface disturbance would result from past, present, and proposed mining and other development activities, which represent approximately 10 percent of the cumulative assessment area.

### 3.4.4 Potential Mitigation and Monitoring

No mitigation measures for soils are recommended.

### 3.4.5 Residual Adverse Impacts

Residual impacts to soils after the Proposed Action would include the unreclaimed pit highwalls.




Legend

- County Boundary
- Interstate 80
- Road
- Stream or Intermittent Stream
- City
- Allotment Boundary
- Cumulative Assessment Area

**Marigold Mine**

**Map 3-12**

**Cumulative Assessment Area for Soils, Vegetation, and Range Resources**

# 3.5 Vegetation Resources

## 3.5.1 Affected Environment

The project area is located in the Central Great Basin floristic region of the Intermountain physiographic region. This floristic region is characterized by mountain ranges trending north and south with large, extensive valleys located between the mountain ranges. This region covers about 30,250 square miles in central Nevada.

### 3.5.1.1 Vegetation

Site-specific vegetation studies were conducted in the project area during 1997 (JBR 1998). The baseline vegetation studies included the delineation of plant communities based on aerial photograph interpretation and on-site vegetation surveys. Vegetation sampling was completed at representative sites within these plant communities to determine species composition, forage production, and other vegetative parameters.

The project area is dominated by two major upland plant communities; the shadscale-cheatgrass community and the sagebrush-spiny hopsage community (Map 3-13). In addition, lands previously disturbed by mining occur in the project area. Small communities of greasewood-big sagebrush are found in the Ames Spring area. Limited riparian communities are associated with the spring sites; isolated riparian plant species occur along the southern portion of Trout Creek. Small, scattered populations of Utah juniper occur near the southernmost portion of the project area. The distribution of these communities is directly related to subtle differences in landscape position, aspect, soil texture, and soil moisture.

The shadscale-cheatgrass community is predominantly found in the northern half of the project area, which is characterized by gently sloping alluvial fans. The community also occurs on some south-facing foothills where green rabbitbrush occurs as a subdominant shrub. Other shrubs found in this community include budsage, rubber rabbitbrush, Nevada ephedra, horsebrush, and winterfat. Big sagebrush and spiny hopsage occur in areas with higher soil moisture. Where this community was previously burned, the amount of budsage has been greatly reduced, and the amount of cheatgrass is more prevalent. ***Cheatgrass is an annual species that readily invades burned or disturbed areas.*** Common perennial grasses ***within this community*** include bottlebrush squirreltail and Sandberg bluegrass. Characteristic perennial forbs include scarlet globemallow and Indian paintbrush. Shrub cover ranges from less than one percent in the previously burned area to approximately 10 percent. Herbaceous cover ranges from approximately 12 to 30 percent.

The big sagebrush-spiny hopsage community is predominately found in the southern half of the project area, which is characterized by foothills and drainages associated with Battle Mountain. Shadscale and green rabbitbrush are subdominant shrubs that are locally abundant. Other shrubs in the community include greasewood, Nevada ephedra, budsage, winterfat, and horsebrush. The herbaceous cover is dominated by cheatgrass. Other prominent grasses include Indian ricegrass and pine bluegrass. ***Tumble mustard*** is the dominant forb, with scattered occurrences of rockcress, scarlet globemallow, hawksbeard, phlox, wild onion, and death camas. Shrub cover ranges from approximately 9 percent on the eastern facing slopes to approximately 16 percent in gentle slope areas. Herbaceous cover ranges from approximately 7 to 45 percent.

An isolated greasewood-big sagebrush community occurs in the vicinity of Ames Spring, which is located in the southeastern portion of the project area. Shadscale is the prominent subdominant shrub in this community, with only isolated occurrences of Nevada ephedra and horsebrush. Cheatgrass is the dominant grass species in the community. Other grasses include Sandberg bluegrass and bottlebrush squirreltail. Dominant forbs include ***tumble mustard***, primrose, clasping pepperweed, buttercup, alkali

dropseed, and sumpweed. Shrub cover is approximately 16 percent, with greasewood and big sagebrush comprising approximately 94 percent of the shrub cover within this community. Herbaceous cover is approximately 7 percent.

Riparian-wetland communities occur in two locations within the project boundary. These occurrences are associated with natural springs (Mud Spring and Ames Spring) that are found in the southeastern portion of the property controlled by GMMC. The dominant species in these wetlands include foxtail barley, meadow barley, rabbitfoot grass, wiregrass, monkeyflower, curly dock, yarrow, and buttercup. The lower portions of Trout and Cottonwood Creeks, which intersect the project area, are classified as intermittent drainages and support a limited amount of riparian-wetland vegetation.

Disturbed areas support a mixture of native vegetation associated with the shadscale-cheatgrass and big sagebrush-spiny hopsage communities and weedy species. Weedy species that are found in the project area include cheatgrass, tansy-mustard, tumblemustard, clasping pepperweed, halogeton, prickly lettuce, sumpweed, fiddleneck, and whitetop.

## 3.5.2 Environmental Consequences

### 3.5.2.1 Proposed Action

Proposed mine development and operation would disturb or remove a maximum of 674 acres of vegetation and approximately 43 acres of previously disturbed land. Of the 674 acres of vegetation to be removed or disturbed, approximately 502 acres would be shadscale-cheatgrass vegetation and approximately 172 acres would be sagebrush-spiny hopsage vegetation. No removal or disturbance of vegetation would occur within the greasewood-big sagebrush community. ***The removal of mature shrubs for a period greater than 10 years would be considered a long-term impact.*** Based on reclamation studies that have been conducted for the existing operations, the growth rate of shrubs is very rapid and mature-sized shrubs would likely be established approximately 3 to 5 years after reclamation. ***Therefore, long-term impacts to shrub-dominated communities are not anticipated to occur in reclaimed areas.***

No removal or disturbance of vegetation would occur within the riparian-wetlands community as a result of mine development or operation. However, mine development and operation would result in the filling and excavation of 1.3 acres of other waters of the U.S. (i.e., small, intermittent drainages), which primarily support upland vegetation. Impacts to Waters of the U.S. are described in Section 3.1, Water Resources and Geochemistry.

Under the Proposed Action, vegetation would be removed during development or expansion of the waste rock dumps, pit areas, heap leach pads, haul road and access roads, realignment of the Buffalo Valley Road, and construction of water diversions, new solution and storm water ponds, and other proposed facilities. Existing vegetation at the proposed media stockpile sites would be buried by growth media. Disturbance also would include trampling of vegetation caused by the use of vehicles and heavy machinery.

GMMC has committed to coordinate with the NDEP and the BLM to minimize the spread of noxious weeds throughout the project area (Section 2.2.19, Reclamation). However, minor populations of weedy annual species, such as halogeton, Russian thistle, and cheatgrass may become established in localized areas. Weedy species rapidly invade disturbed areas and initially hinder the re-establishment of more desirable perennial grasses and forbs by competing with them for moisture during the initial years following disturbance or seeding. Under GMMC's current Reclamation Plan, noxious and invasive weed controls would be implemented during vegetation establishment to minimize competition from weedy species and maximize the establishment of desirable species.

LEGEND

PROPOSED FACILITIES

PRIVATE LAND/PUBLIC LAND CLAIM BOUNDARY

EXISTING PERMIT BOUNDARY

PROPOSED PERMIT BOUNDARY

VEGETATION TYPES

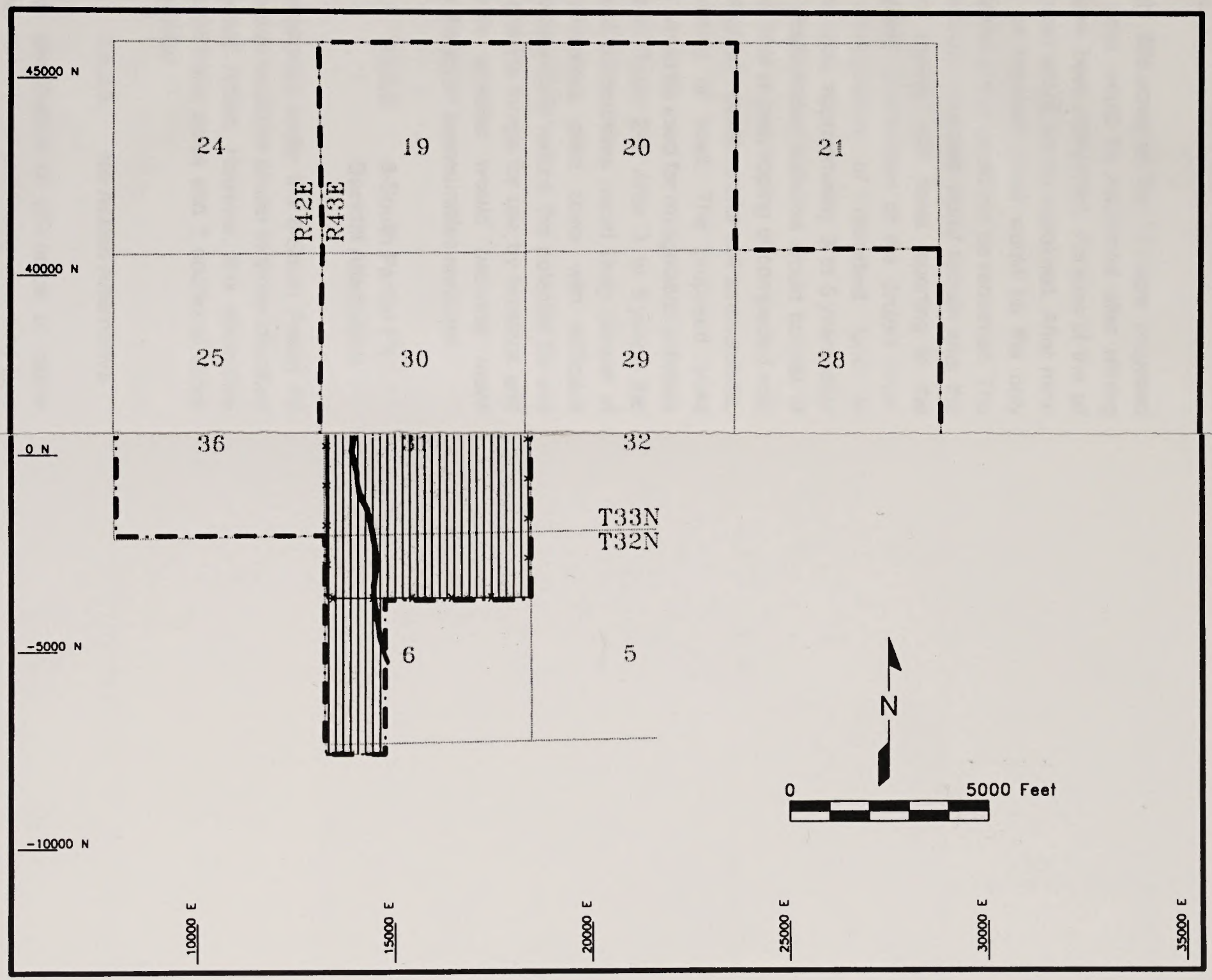
SHADSCALE/CHEATGRASS

BIG SAGEBRUSH/SPINY HOPSAGE

GREASEWOOD/BIG SAGEBRUSH

RIPARIAN OR WETLAND VEGETATION ASSOCIATED WITH

Source: JBR Environmental Consultants 1998




Marigold Mine

Map 3-13

Plant Communities Within the Project Area

dropseed, and sumpweed. Shrub cover is approximately 16 percent, with greasewood and big sagebrush comprising approximately 94 percent of the shrub cover within this community. Herbaceous cover is approximately 7 percent.

Riparian-wetland communities occur in two locations within the project boundary. These occurrences are associated with natural springs (Mud Spring and Ames Spring) that are found in the southeastern portion of the property controlled by GMMC. The dominant species in these wetlands include foxtail barley, meadow barley, rabbitfoot grass, wiregrass, monkeyflower, curly dock, yarrow, and buttercup. The lower portions of Trout and Cottonwood Creeks, which intersect the project area, are classified as intermittent drainages and support a limited amount of riparian-wetland vegetation.

Disturbed areas support a mixture of native vegetation associated with the shadscale-cheatgrass and big sagebrush-spiny hopsage communities and weedy species. Weedy species that are found in the project area include cheatgrass, tansy-mustard, tumblemustard, clasping pepperweed, halogeton, prickly lettuce, sumpweed, fiddleneck, and whitetop.

## 3.5.2 Environmental Consequences

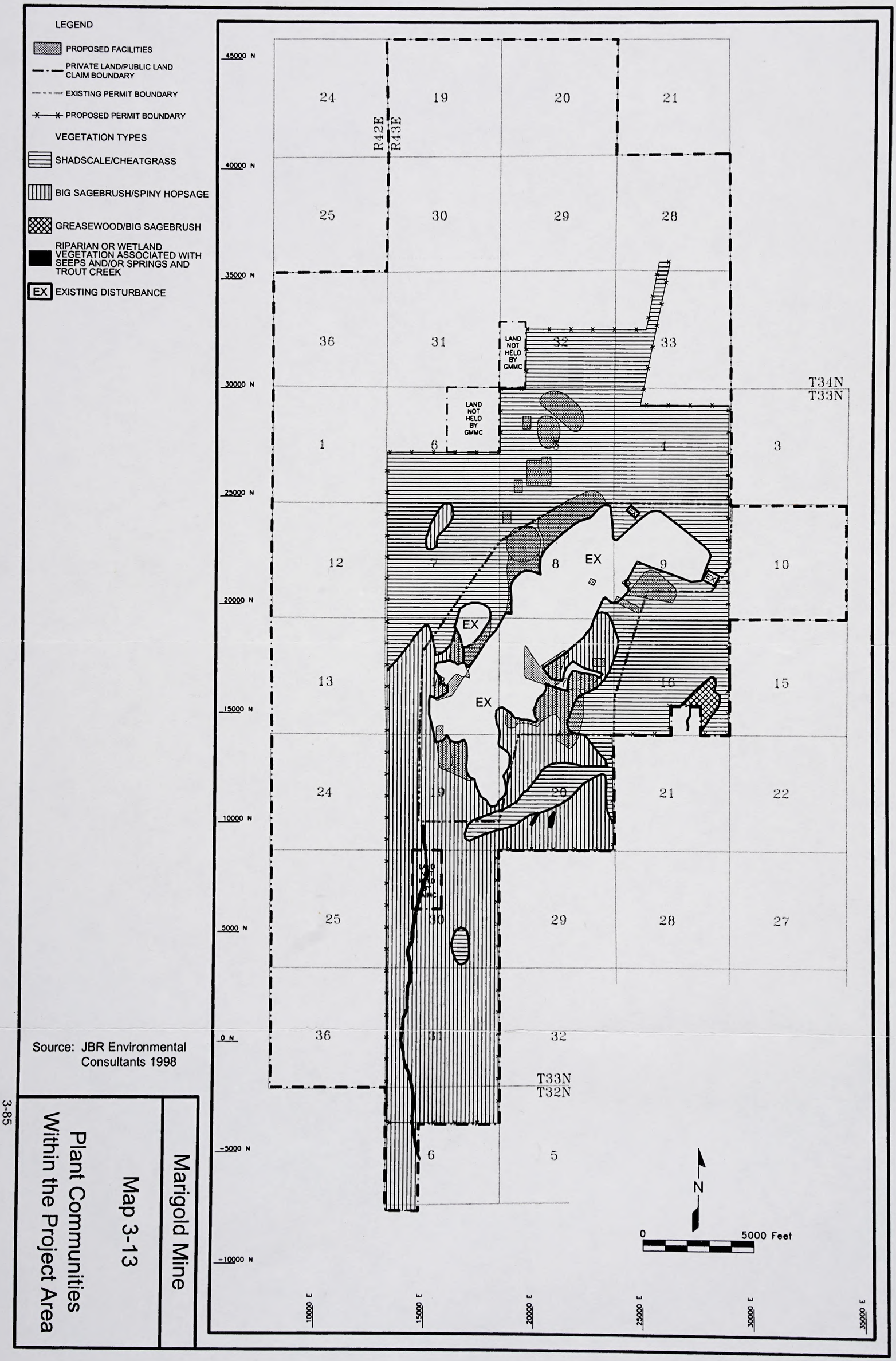
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No removal or disturbance of vegetation would occur within the riparian-wetlands community as a result of mine development or operation. However, mine development and operation would result in the filling and excavation of 1.3 acres of other waters of the U.S. (i.e., small, intermittent drainages), which primarily support upland vegetation. Impacts to Waters of the U.S. are described in Section 3.1, Water Resources and Geochemistry.

Under the Proposed Action, vegetation would be removed during development or expansion of the waste rock dumps, pit areas, heap leach pads, haul road and access roads, realignment of the Buffalo Valley Road, and construction of water diversions, new solution and storm water ponds, and other proposed facilities. Existing vegetation at the proposed media stockpile sites would be buried by growth media. Disturbance also would include trampling of vegetation caused by the use of vehicles and heavy machinery.

GMMC has committed to coordinate with the NDEP and the BLM to minimize the spread of noxious weeds throughout the project area (Section 2.2.19, Reclamation). However, minor populations of weedy annual species, such as halogeton, Russian thistle, and cheatgrass may become established in localized areas. Weedy species rapidly invade disturbed areas and initially hinder the re-establishment of more desirable perennial grasses and forbs by competing with them for moisture during the initial years following disturbance or seeding. Under GMMC's current Reclamation Plan, noxious and invasive weed controls would be implemented during vegetation establishment to minimize competition from weedy species and maximize the establishment of desirable species.




Source: JBR Environmental Consultants 1998

Marigold Mine

Map 3-13

Plant Communities Within the Project Area

Approximately 656 acres of the 717-acre proposed disturbance area would be reclaimed after mining operations have been completed. Portions of the pit areas (61 acres) would not be reclaimed. After mine closure, the pit highwall areas would be the only project components that would not be reclaimed. The stabilized, diversion channels would remain after the completion of mining, with flows reporting to the original channels downstream of the project area. Successful revegetation of disturbed land is anticipated to occur approximately 3 to 5 years after reclamation. Reclamation activities would consist of the grading of final slopes, ripping of compacted soil, application of growth media and/or soil amendments, and broadcasting of seed. The proposed seed mixtures that would be used for revegetation activities are provided in Table 2-6. After 3 to 5 years, the reclaimed plant communities would likely consist of adequate herbaceous plant cover with sufficient diversity to substantially reduce the potential for soil erosion and provide forage for use by livestock and wildlife. ***Shrub species would become more prevalent as the plant communities matured.***

#### 3.5.2.2 8-South Partial Pit Backfill Alternative

Impacts to vegetation under the 8-South Partial Pit Backfill Alternative would be similar to those identified for the Proposed Action. However, this alternative would disturb 85 fewer acres and 2 additional acres would be reclaimed.

#### 3.5.2.3 No Action Alternative

The additional disturbance of 674 acres of native vegetation and 43 acres of previously disturbed land would not occur under the No Action Alternative. Vegetation impacts would be to limited to ongoing, permitted mining and exploration activities. Reclamation activities, weed control, and subsequent revegetation would occur earlier under this Alternative, as compared to the Proposed Action.

### 3.5.3 Cumulative Impacts

The cumulative assessment area for vegetation resources includes the North Buffalo and Copper Canyon grazing allotments, which covers approximately 203,000 acres (Map 3-12). Past and present disturbances within the North Buffalo and Copper Canyon grazing allotment boundaries include approximately 12,393 acres that were disturbed during mining and other development activities. This disturbance accounts for approximately 6 percent of the cumulative assessment area. Mine development and operation activities associated with the proposed project would result in the disturbance or removal of 717 acres of vegetation or less than 1 percent of the cumulative assessment area. Future activities could effect 6,325 acres of vegetation.

A total of 19,435 acres of surface disturbance would result from past, present, and future mining and other development activities in the cumulative assessment area, which represents approximately 10 percent of the 203,000-acre cumulative assessment area. The loss of vegetation during development and operation activities would result in the loss of livestock and wildlife forage and protective cover for wildlife. The loss of mature shrubs would be minimal relative to the total acreage of sagebrush and shadscale communities that occur in the cumulative assessment area. The majority of the mining-related surface disturbance would be reclaimed after mine operations cease.

### 3.5.4 Potential Mitigation and Monitoring

Reclamation activities and weed control measures are included as part of the Proposed Action (Section 2.2.19, Reclamation) and would substantially reduce potential impacts to vegetation resources. All areas that are pre-stripped of vegetation and left fallow (not used within a 90-day period) will be seeded with the approved seed mixture in order to reduce erosion and deter establishment of noxious weeds.

### 3.5.5 Residual Adverse Impacts

Residual impacts to vegetation would include the permanent removal of vegetation from portions of the pit areas (61 acres). A long-term change in vegetation composition of 717 acres (i.e., mature shrub-dominated communities to grass- and forb-dominated communities) may occur as a result of the Proposed Action.

# 3.6 Wildlife and Fisheries Resources

## 3.6.1 Affected Environment

### 3.6.1.1 Aquatic Biology

Surface water in the project area is limited to two intermittent creeks and two isolated spring complexes. Both Cottonwood Creek and Trout Creek are classified as perennial streams in the higher elevations of the Battle Mountain Range. The intermittent portions of both creeks in the project area support little vegetation. Mud and Ames Spring complexes, located in or near the southeastern edge of the project area support a number of mesic-habitat plant species (JBR 1998).

In the upper reaches of Cottonwood Creek and Trout Creek, a viable brook trout fishery occurs where perennial flows are present and deep pools with dense willow cover provide suitable habitat for fish (BLM 1998). However, little riparian habitat and no fisheries are present in the lower reaches of Cottonwood and Trout Creeks within the project area (Lamp 1999).

### 3.6.1.2 Terrestrial Wildlife

**Habitat**

Wildlife habitat associated with the project area is limited to two dominant plant communities, the shadscale-cheatgrass community, which is found on gentle slopes and south-facing foothills at lower elevations, and the big sagebrush-spiny hopsage community, which occurs in the foothills and drainages at higher elevations, as described in Section 3.5, Vegetation Resources, and shown on Map 3-13. Overall habitat value for wildlife resources ranges from low to moderate, transitioning from the shadscale-cheatgrass community located in the northern half of the project area to the higher quality sagebrush-spiny hopsage community that occurs in the southern portion of the project area.

Overall water availability is the primary limiting factor for wildlife in the project region. The project area encompasses arid, upland habitats dissected by intermittent drainages, including Cottonwood Creek and Trout Creek. Although Cottonwood Creek and Trout Creek are perennial in the upper elevations of Battle Mountain, they become intermittent in the lower reaches of Battle Mountain within the project area. Both reaches are typically dry by May or June, depending on winter precipitation. The lower portions of these streams provide little available water and, consequently, support limited riparian habitat for wildlife forage and cover. Mud Spring and Ames Spring are located in or near the southeastern edges of the project area (JBR 1998). Comparatively, the streams and springs in the project area provide higher habitat value for wildlife than the surrounding areas, based on the amount of cover and forage availability, increased plant diversity, and additional moisture.

A number of surveys of both resident and migratory wildlife have been conducted in and adjacent to the proposed mine expansion area (JBR 1998). These studies examined the overall use of the area by terrestrial vertebrates and special status species. Representative wildlife species that may occur in the vicinity of the project are listed in Appendix ***C***. Survey specifics pertaining to sensitive wildlife resources are discussed further in Section 3.7, Special Status Species.

**Game Species**

Mule deer, pronghorn, and mountain lion are the only big game species that are present within the Battle Mountain Range (BLM 1998). The project area lies within Unit 151 (Battle Mountains in Management Area 15). Mule deer habitat within and near the project area includes big sagebrush, low sagebrush, shadscale, and grassland communities. The limiting habitat component for mule deer in the Battle Mountain Range is summer range (NDOW 1999a; Lamp 1999). Mule deer winter range occurs in the foothills within the southern portion of the project area. This area is particularly valuable during severe winter periods when climatic conditions force deer to

abandon the higher elevation shrub zones (BLM 1997). Although mule deer are limited on the mine site, surveys conducted by NDOW biologists have documented high levels of deer use on the lower slopes of the Battle Mountain Range near the project area during the spring season. Fawn production within Management Area 15 in the Battle Mountain Range has been increasing since 1994 (NDOW 1999a). Fawn production ranged from 38 fawns per 100 does in 1994 to 83 fawns per 100 does in 1998. The average fawn production since 1994 was approximately 61 fawns per 100 does (NDOW 1999a). No deer estimates were analyzed for individual units including Battle Mountains (NDOW 1999a). Water availability, forage quality, cover, and weather patterns typically determine the level of use and movement of deer through an area. As discussed above, water is the primary limiting factor for mule deer in the immediate project area, particularly near high quality forage, which somewhat restricts the distribution of resident deer populations.

Pronghorn have been observed in the vicinity of the project area during the last several years. It is not known if this is a re-establishing population or a temporary expansion due to the increased amount and type of vegetation in the area that has resulted from high precipitation levels in the last 3 to 4 years. Exact population numbers are not available.

Mountain lions occupy the higher elevations to the south of the project area, and are closely associated with the resident mule deer herd. Although mountain lions are known to occur in the Battle Mountain Range, the lion population near the immediate project area is likely low, due to the habitat types in and near the areas proposed to be disturbed by the project, the amount of human presence around the mine, and the limited extent of mule deer use recorded for the mine site (BLM 1997).

Upland game birds are not abundant, but may occupy portions of the project area. Sage grouse are discussed in Section 3.7, Special Status Species. Both mourning dove and chukar have been documented using the project area. Mourning dove is the most commonly observed game bird species within the project area, but only as a summer resident (JBR 1998). Chukar are most commonly observed using the waste rock dumps within the project area (NDOW 1999b). Valley quail have been observed along creeks near the project area (NDOW 1999b). Other game bird species found in the region are presented in Appendix ***C***.

**Nongame Species**

Nongame species are widely distributed, occupying a variety of habitat types and elevations within the project region. Representative nongame mammals for the region are listed in Appendix ***C***.

Nongame species include several bats that may occur in the project area. The scientific literature suggests that various bat species have become dependent on abandoned mines for roosting and hibernacula (BLM 1998). Caves and crevices also provide adequate shelter for roosts and hibernacula. Surveys that were conducted in 1997 and 1998 identified several bat species using the Red Rock Adit for roosting in spring, summer, and early fall. These species included Townsend's big-eared bats, pallid bats, long-legged myotis, and small-footed myotis (JBR 1998; BLM 1999). Although no myotis or other bat species were observed using the adit as a hibernaculum, during the 1997/1998 surveys and the adit does not have the characteristics preferred by bats for use as a hibernaculum, myotis are difficult to detect and individual bats could potentially use the adit in the winter. Other representative bats that could occur in the project region are listed in Appendix ***C***.

Nongame birds encompass a variety of passerine and raptor species. Regional bird species are presented in Appendix ***C***. Nongame birds include a diversity of neotropical migrants; birds that breed in North America and winter in the neotropical region of South America. These bird species are considered integral to natural communities, as they often act as environmental indicators.

Passerines or song birds occupy the entire range of habitats that occur within the project area. However, due to the higher level of plant diversity and structure, larger number of nest sites, and greater food base, the sagebrush/spiny hopsage community and small riparian areas located in the southern portion of the project area support a greater number of birds than the shadscale/cheatgrass community to the north.

A number of raptor species have been observed using the project area including golden eagles, red-tailed hawks, northern harriers, American kestrels, and great-horned owls (JBR 1998). Additional regional species could include the ferruginous hawk, Swainson's hawk, burrowing owl, and bald eagle, as discussed in Section 3.7, Special Status Species. Evidence of an old nest and foraging perches suggest that prairie falcons may have previously nested on a rock outcrop north of the Mud Springs area. In addition, a possible burrowing owl nest was recorded north of Ames Springs in 1997. Other nesting activity observed in the project area included several unoccupied stick nests that were presumably used by ravens prior to 1997, as evidenced by white-wash and feathers at the nest sites (JBR 1998). No habitat in or adjacent to the proposed mine expansion area would be considered suitable for accipiter nesting. However, Cooper's hawks have been documented within the Battle Mountain Range (BLM 1998). The northern goshawk is presented in Section 3.7, Special Status Species. A number of other raptor species may use the project area and its surrounding habitats for foraging and possibly nesting, although suitable breeding habitat is limiting. Appendix ***C*** lists the raptor species identified for the project region.

Other nongame species in the region would include common reptiles such as those described in Appendix ***C***. Amphibians would be limited in the immediate project area, due to the lack of water sources; however, they could occur within the project region.

## 3.6.2 Environmental Consequences

### 3.6.2.1 Proposed Action

No impacts to aquatic resources would be expected from the proposed mine expansion activities. The proposed project would not directly affect any natural perennial water sources, since none are located within the proposed disturbance areas outlined by the project components. No indirect effects would be anticipated to the naturally occurring springs (i.e., Ames and Mud Springs), based on the analysis presented in Section 3.1, Water Resources and Geochemistry. Based on these factors, no direct or indirect impacts to terrestrial wildlife species associated with Cottonwood and Trout Creeks or Ames and Mud Springs would be anticipated. In addition, no potential off-site impacts to perennial water sources in the Battle Mountain Range or along the Humboldt River (i.e., cumulative assessment area) from groundwater drawdown have been identified.

The potential level of impacts to terrestrial species and their associated habitats generally depends on the temporal and spatial relationships of these resources with the proposed project components. Based on the available habitat types in the project area, their relative value to both resident and migratory wildlife, and historical use of the area, the overall effects to terrestrial wildlife from proposed mine expansion would be considered low to moderate. Direct impacts would include limited direct mortalities from mine development, habitat loss and encroachment into the Battle Mountain Range foothill region, incremental habitat fragmentation, and animal displacement. Indirect impacts would primarily encompass increased noise and expanded human presence.

Generally, mine development results in the loss of the less mobile species and the displacement of animals from the project area into adjacent habitats, which are typically assumed to be at or near their carrying capacities. Therefore, displaced animals would increase intraspecific competition and would be assumed to be lost from the population. Displacement of wildlife from project-related activities would primarily affect those species dependent on the transitional foothill zone located between the lower elevational shadscale community and the higher elevational habitats. However, the habitats in the project area that would be affected by mine expansion are not considered unique or uncommon and no effects to perennial water sources have been identified. The primary concern identified for terrestrial wildlife resources would be the incremental direct and indirect effects to native habitats in the region.

Implementation of the proposed project would result in the direct loss of a maximum of 674 acres of native vegetation and 43 acres of previously disturbed land, which support a limited amount of native vegetation and weedy species. The loss of the 674 acres of native vegetation would be considered a short-term impact during the life of the project until final site reclamation is completed. Of the 674 acres of native habitats that would be disturbed by the proposed project, 656 acres would be reclaimed, leaving 18 acres not reclaimed for post-mining use. The 18 unreclaimed acres would be considered a long-term and permanent habitat loss.

A total of 61 acres of the 717 acres of total disturbance would not be reclaimed and would be lost as wildlife habitat for the long term. This anticipated loss of deer winter range would be a small, incremental reduction in the amount of available winter range for the Battle Mountain population. This incremental loss would not be considered significant, however, based on the low overall habitat quality in the immediate mine area for resident mule deer, the degree of existing disturbance from past mining and exploration activities, and the amount of suitable winter range in the surrounding region that is available for wintering deer. No big game migratory or movement corridors would be affected by the proposed project. Impacts to mountain lions would be closely associated with the distribution of the mule deer herds and would, therefore, be expected to be low.

Generally, potential impacts to breeding birds from the proposed mine expansion would encompass possible direct loss of nests (e.g., crushing) or indirect effects (e.g., abandonment) from increased noise and human presence within close proximity to an active nest site. However, GMMC has committed to conducting breeding bird surveys ***in all*** suitable habitats prior to ground disturbance, if construction were to occur between March and July (see Section 2.2.18.5, Wildlife and Livestock Protection). If active nests are documented, GMMC also has committed to coordinating with the BLM to develop and implement appropriate protection measures to minimize effects to nesting birds. These measures could include avoidance, buffer zones, construction constraints, etc., and would be determined on a case-by-case basis. An option to these surveys would be clearing vegetation outside of the breeding season (March through July) to avoid impacting nesting birds, as presented in Section 2.2.18. Residual impacts to nesting birds that may occupy the project area would be limited to the incremental habitat loss associated with the mine expansion. This loss, however, would not be significant, given the amount of native habitats in the surrounding region, the lack of unique habitats or documented rare bird species in the project area, and the extent of the existing mining activity in the project area (i.e., reduced carrying capacity of the native habitats immediately adjacent to the mine).

***Implementation of these environmental protection measures and other measures described in Section 2.2.18.5, Wildlife and Livestock Protection, would minimize impacts to migratory birds in the project area, which are protected under the Migratory Bird Treaty Act (MBTA) and the Executive Order effective January 11, 2001 (Federal Register 2001).***

Potential effects to upland game birds from mine development are expected to be low. The lack of known breeding sites (e.g., sage grouse leks) in the immediate project area, the limited amount of quality habitat in the proposed expansion area, and the maintenance of Ames and Mud Springs would aid in minimizing impacts to upland game birds. No direct or indirect impacts to perennial water sources within the higher elevations of the Battle Mountain Range are anticipated. Consequently, no impacts to nesting, foraging, or brooding game birds are anticipated.

Realignment of the existing 120-kV transmission line along the northern perimeter of the project area would not increase the potential avian strike hazard, due to the presence of the existing line. Collision potential is typically dependent on variables such as the location of high-use habitats (e.g., nesting, foraging, roosting), line orientation to flight patterns and movement corridors, species composition, visibility, and line design (Beaulaurier et al. 1982; Anderson 1978). No increased electrocution hazard would be anticipated for raptors attempting to perch on the structures. The configuration of transmission lines greater than 69-kV typically does not present an electrocution potential, based on conductor placement and orientation (APLIC 1996).

Impacts to high-profile species from increased human presence is typically proportional to the size of a construction and operational work force, overall land use and recreational demands, and other development and associated activities in the region. The construction work force for the proposed mine expansion would increase by 25 to 30 additional employees for the life of mine, as described in Section 3.12, Social and Economic Values. This anticipated increase in the number of mine personnel would not likely result in significant adverse effects to local wildlife resources. First, future noise levels would not be expected to increase substantially beyond existing levels, as presented in Section 3.11, Aesthetics, and since the mine is located near I-80, the potential for a large increase in vehicle-related mortalities would be limited to the immediate expansion area. Based on the location of these areas relative to roads and I-80, road kills would likely be minimal.

The increased number of personnel during mine construction could result in additional dispersed recreation (e.g., off-road vehicle use) along the Battle Mountain Range, possibly resulting in increased wildlife harassment. Although this level of use would be expected to be low, it would result in incremental effect within the region. Poaching is often the greatest adverse impact to wildlife from increased human presence (Streeter et al. 1979), particularly for big game species. However, other high-profile species are often harassed, including large raptors (e.g., eagles and buteos), predators (e.g., coyote), and roosting bats in caves and mine workings. Although these impacts could occur from the anticipated increase in construction personnel, the effects would be short-term and would be expected to return to current levels following mine development. Also, the environmental training for mine personnel committed to by GMMC in Section 2.2.18.8 would aid in minimizing these indirect effects to wildlife resources.

The EIS analysis examined the potential short- and long-term effects from both water quality and water quantity for wildlife resources. It was determined that the proposed project would not result in adverse impacts from degraded water quality or decreased water availability, as discussed below.

Short-term effects from water quality would be limited to the potential exposure of terrestrial ***and avian*** wildlife to cyanide solutions used on-site. Sodium cyanide is lethal to wildlife, and recent information provided by the NDOW ***and USFWS*** indicates that certain bat ***and avian*** species exhibit a delayed influence from cyanide poisoning. These study results suggest that an increased number of bats ***and birds*** may be affected by cyanide solutions than previously thought, and individuals may be succumbing to cyanide poisoning away from mine areas. Therefore, these mortalities would be less likely to be found and reported. As part of the proposed project, GMMC has committed to fencing and netting cyanide solution ponds and secondary containment structures to

exclude wildlife from potentially lethal solutions ***and monitoring of heap leach surfaces for ponding of cyanide solution. Evidence of ponding on the heap leach pad surface results in the movement of the sprinkler head or ripping the surface to promote infiltration. These measures have proven effective in limiting avian exposure to cyanide solution. Implementation of the Proposed Action would increase the period of time over which the potential exposure would occur and the potential for sub-lethal effects may occur.*** These measures are described in Section 2.2.18.5. Therefore, based on GMMC's committed protection measures, potential impacts to wildlife resources from cyanide ingestion would be low. These measures have been developed in accordance with the BLM's cyanide management policy and the NDOW's Industrial Artificial Pond Permit. GMMC also is required to report all wildlife mortalities to the BLM and NDOW, as required by the Federal and state approval and permitting processes (Section 2.2.18.5).

GMMC has committed not to mine the proposed 8-North Pit to a level that would intercept groundwater (see Section 2.2.2.1). Therefore, no effects to wildlife are anticipated from development of this pit.

No impacts to naturally occurring seeps or springs in or adjacent to the mine area would be anticipated by implementation of the proposed mine expansion (see Section 3.1, Water Resources and Geochemistry). Given the groundwater analysis, no effects to perennial surface water resources or the associated riparian vegetation in the vicinity of the mine (e.g., Battle Mountain, Humboldt River) have been identified. Therefore, no impacts to terrestrial wildlife species that are dependent on these sources would occur. The diversion of Cottonwood and Trout Creeks would not be expected to significantly affect native wildlife, based on the degree of existing mining disturbances present in the project area, the relative low value of these ephemeral drainages along their lower reaches, and the lack of riparian habitat in these lower elevations that may support a diversity of biota.

No additional impacts to natural resources would occur from the transport or use of hazardous chemicals associated with the proposed project. No incremental increase in the use of sodium cyanide, sodium hydroxide, or diesel fuel, as part of the proposed mine expansion would occur; therefore, no additional risks to wildlife and associated habitats would occur from a potential chemical spill during truck transport.

#### 3.6.2.2 8-South Partial Pit Backfill Alternative

Overall impacts from implementation of the 8-South Pit Partial Backfill Alternative would parallel those described for the proposed project. This alternative would result in the direct loss of a maximum of 589 acres of native vegetation as compared to 674 acres for the proposed project. The loss of this acreage would be considered a short-term impact during the life of the project, until final site reclamation is completed. Partially backfilling the 8-South Pit would prevent a future pit lake from developing; therefore, possible exposure of native wildlife to chemicals of concern in the pit lake water would not occur.

#### 3.6.2.3 No Action Alternative

Under the No Action Alternative, approximately 674 acres of native wildlife habitat would not be disturbed or lost, as under the proposed mine expansion. Additional habitat fragmentation and animal displacement would not occur, limiting the effects to natural resources to existing conditions. The levels of human use would remain the same as the current levels.

### 3.6.3 Cumulative Impacts

A cumulative effects analysis for terrestrial wildlife typically varies with the species, its associated habitat types, issue sensitivity, and the animal's mobility. The cumulative analysis focused on the historic mining and exploration activities and livestock grazing

combined with the proposed project and future mining programs that are currently proposed.

The cumulative impact analysis focused on the regional wildlife resources and how they may be susceptible to the cumulative actions identified for this project. The analysis assumed that: 1) human use of the cumulative effects area would continue to increase with or without implementation of the proposed project, 2) wildlife habitats are currently at their respective carrying capacities in and adjacent to the proposed mine expansion area, and 3) the overall region has been previously affected by the historic and current mining activities.

No impacts to perennial water or aquatic resources were identified within the cumulative effects area, since no adverse effects to water resources would result from implementation of the proposed project. Cumulative effects to wildlife resources would be directly related to incremental habitat loss, fragmentation, and animal displacement that have primarily resulted from historic mining activities in the cumulative assessment area, forcing animals into smaller patches and limited distributions. Combined with these past effects, these resource issues also would be affected by the present and planned mining activities. Wildlife populations that occur in the cumulative effects area would continue to occupy their respective ranges and breed successfully, although population numbers may decrease relative to the amount of cumulative habitat loss and disturbance from the incremental development.

Overall cumulative impacts from the interrelated projects would parallel those discussed for the proposed project. The increased number of roads from mine exploration would improve human access into more remote areas. The work forces associated with mining construction and operation would increase traffic levels in the region, in addition to increasing the employees' exposure to the area. This exposure would typically result in additional human use of the region, increasing pressure on resident wildlife populations. Certain resources are more susceptible to impacts than others, such as riparian zones, seeps and springs, seasonal ranges, movement corridors, and active breeding sites (e.g., leks, raptor nests, brooding habitat). As stated for the proposed project, impacts to high-profile species are proportional to the increase in human presence, land use and recreational demands, and other regional development.

### 3.6.4 Potential Mitigation and Monitoring

No additional mitigation measures have been developed for either aquatic or terrestrial wildlife resources, based on the environmental protection measures committed to by GMMC and outlined in Section 2.2.18.5, Wildlife and Livestock Protection, and Section 2.2.19.8, Facility Reclamation.

### 3.6.5 Residual Adverse Impacts

Residual effects to wildlife resources from the Proposed Action would include the short-term loss of 717 acres and long-term loss of native habitat associated with the unreclaimed portions of the pits (61 acres). Other residual impacts would include the incremental habitat loss and displacement of wildlife species. Increased human presence would continue to affect the overall distribution of wildlife.

Approximately ***656*** acres of disturbed habitat would be reclaimed after mining ceases. Approximately 61 acres of the Proposed Action disturbances would not be reclaimed.

# 3.7 Special Status Species

Special Status Species are those species for which State or Federal agencies afford an additional level of protection by law, regulation, or policy. Included in this category are Federally listed species that are protected by the Endangered Species Act (ESA), species of concern as identified by the U.S. Fish and Wildlife Service (USFWS), and species designated as state sensitive by the BLM. In addition, there is a Nevada State Protected Animal List (NAC 501.100 – 503.104) that BLM has incorporated, in part, into the BLM's sensitive species list.

As defined by the ESA, an endangered species is any species that is in danger of extinction throughout all or a significant portion of its range. A threatened species is any species that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range. Proposed species are those that are proposed in the Federal Register by the USFWS to be listed as threatened or endangered. Species of concern are taxa for which existing information indicates that listing may be warranted, but for which substantial biological information to support a proposed rule is lacking. Species of concern are not specifically afforded the same protection under the ESA as threatened or endangered species, but federal agencies are required to consider them in the agency's planning and decision making processes. The BLM also maintains a list of plant and animal species that are designated as sensitive for which population viability is a concern, as warranted by a downward trend in population numbers, density, or habitat conditions that would reduce a species existing distribution.

In accordance with the ESA, the lead agency in coordination with the USFWS must ensure that any action that they authorize, fund, or carry out would not adversely affect a Federally listed threatened or endangered species. In addition, it is currently BLM's policy that agency actions do not contribute to the Federal listing of any Federal candidate species, species of concern, or sensitive species, as threatened or endangered.

## 3.7.1 Affected Environment

The special status species identified by the USFWS (1999) and Nevada Natural Heritage Program (NNHP) (1998, 1999) for the project area and cumulative assessment area are listed in Table 3-18. Although a number of sensitive terrestrial and aquatic species occur in northern Nevada, few species have been documented for the immediate project area. In support of this document and previous mine expansions, baseline surveys have been conducted in and near the project area (BLM 1998; JBR 1998). The following discussions summarize known data for the special status species initially identified for the proposed project by the applicable agencies.

### 3.7.1.1 Plants

One BLM state sensitive species, the Elko rockcress, could potentially occur within or adjacent to the project area, based on this plant's habitat associations (Table 3-18). The Elko rockcress is typically associated with gently north-sloping, sagebrush-dominated habitats with a high moss/ cryptogamic cover over silty substrates (NNHP 1999). General habitat surveys conducted in 1997 recorded no special status species within the project area (JBR 1998). One state-sensitive plant species that has been documented in the vicinity of the project is the sand cholla cactus (JBR 1998) (Table 3-18). This cactus is typically associated with big sagebrush and shadscale. It is thought to be widely distributed and uncommon throughout its range (Mozingo and Williams 1980). All cacti and yucca species are protected by Nevada state law.

Nine additional species that were identified by the NNHP were considered but eliminated from the analysis based on the lack of suitable habitat, soil composition, geology, and elevational range of these species. These species included the Ophir rockcress, Goodrich biscuitroot, Nevada willowherb, windloving buckwheat, Lewis buckwheat, Nevada dune beardtongue, Tiehm beardtongue, obscure scorpion plant, and least phacelia.

**Table 3-18**
**Special Status Wildlife Species**
**Identified for the Proposed Project**

| Common Name | Scientific Name | Federal Status[1] | Potential Occurrence in the Project Area and Vicinity[2] |
|---|---|---|---|
| **PLANTS** | | | |
| Elko rockcress | *Arabis falcifructa* | BLM | U |
| Sand cholla cactus | *Opuntia pulchella* | State | R-V |
| **BIRDS** | | | |
| Bald eagle | *Haliaeetus leucocephalus* | FT | W, M |
| Peregrine falcon | *Falco peregrinus* | BLM | M |
| Golden eagle | *Aquila chrysaetos* | BLM | R |
| Swainson's hawk | *Buteo swainsoni* | BLM | R-V |
| Ferruginous hawk | *Buteo regalis* | BLM | R-V |
| Northern goshawk | *Accipiter gentillis* | BLM | R-V |
| Burrowing owl | *Athene cunicularia* | BLM | R |
| Sage grouse | *Centrocerus urophasianus* | BLM | R |
| **MAMMALS** | | | |
| Small-footed myotis | *Myotis ciliolabrum* | BLM | R |
| Long-eared myotis | *Myotis evotis* | BLM | U |
| Fringed myotis | *Myotis thysanodes* | BLM | U |
| Long-legged myotis | *Myotis volens* | BLM | R-V |
| Pale Townsend's big-eared bat | *Corynorhinus townsendii pallescens* | BLM | R |
| Pacific Townsend's big-eared bat | *Corynorhinus townsendii townsendii* | BLM | R |
| Spotted bat | *Euderma maculatum* | BLM | U |

[1]FE = Federally endangered.
FT = Federally threatened.
BLM = BLM state sensitive species.
Currently protected by the BLM in Nevada under the BLM's state guidelines.
State = Protected by Nevada State law (NRS 527.060-120).
[2]R-V = Resident in Vicinity: this species has been documented in the project vicinity, which includes habitats surrounding the project area.
R = Resident: this species has been documented in the project area.
W = Winters: this species winters in the vicinity of the project area.
M = Migrates: this species is known to migrate through the project area.
U = Unknown: it is currently unknown whether this species occurs in the study area or vicinity; however, appropriate habitat is present.

### 3.7.1.2 Birds

The USFWS has downlisted the bald eagle to Federally threatened from endangered status (USFWS 1995). No bald eagle nesting habitat occurs in or near the project area; however, migrating eagles do move through the state, and wintering birds would occur within the appropriate winter habitats (e.g., Humboldt River corridor) from December through March. These habitats for wintering birds generally include open water and upland habitats for foraging. In addition to open water, other important habitat components for wintering eagles include suitable trees for diurnal perching and night roosting (Terres 1991; USFWS 1986). Bald eagle wintering habitat exists along the Humboldt River. Wintering birds may forage along the river, when open water permits. Eagle presence in the immediate project area would be infrequent and limited to occasional foraging in the upland habitats.

The American peregrine falcon was delisted as Federally endangered on August 25, 1999. The designated similarity of appearance provision of the Endangered Species Act for the arctic subspecies also has been removed (USFWS 1999). The peregrine falcon continues to be protected under the Migratory Bird Treaty Act and is considered a BLM state sensitive species. Nesting peregrine falcons prefer cliffs in proximity to water and typically forage in riparian zones where avian prey species (e.g., passerines, shorebirds) are abundant (USFWS 1984). Studies have reported that peregrines may travel up to 27 miles from occupied eyries to obtain prey (Enderson and Craig 1997). No eyries are known to occur in the vicinity of the project area. In addition, no primary foraging habitat (e.g., riparian zones) occur in the project area. Peregrine use of the project and cumulative assessment areas would be limited to migrating birds.

The golden eagle is a yearlong resident and is considered to be a common breeder throughout Nevada; however, eagle densities and nesting activity are greatest in the northern third of Nevada (NDOW 1985). Nesting golden eagles prefer suitable cliffs that overlook sagebrush flats, piñon-juniper forests, salt desert shrub, or other habitat capable of supporting a suitable prey base. Highest densities of nesting eagles are typically found along river systems where cliffs border the entire length of the river, and lower densities are found in piñon-juniper habitat and salt desert shrub communities (NDOW 1985). Wintering golden eagles tend to congregate in broad valleys interspersed with agricultural crop lands or sagebrush and desert shrub communities. Golden eagle nesting has been documented in the Battle Mountain area; however, suitable nesting habitat ***(e.g., cliff faces, highwalls in inactive pits)*** in the immediate project area is limited. No active eagle nests have been recorded within the Marigold Mine expansion area (BLM 1997).

The Swainson's hawk is a summer resident of Nevada and, like the golden eagle, is most abundant in the northern third of the state (NDOW 1985). The majority of documented breeding territories in Nevada have been located in agricultural valleys. Swainson's hawks nest in a wide variety of vegetative communities from 4,000 to 6,500 feet in elevation. Nest sites are primarily found in deciduous trees; however, nests also have been found in other vegetation types such as buffaloberry, serviceberry, and sagebrush (NDOW 1985). Although Swainson's hawks have been observed exhibiting territorial behavior along the Humboldt River (BLM 1995), no occupied territories or active nest sites have been documented within the project area.

The ferruginous hawk is a common breeder in many areas of Nevada. This species often nests in trees, on promontory points, rocky outcrops, cut banks, or on the ground (Terres 1991). Preferred breeding habitat in most of the state is scattered juniper forests at the interface between piñon-juniper and desert shrub communities that overlook broad valleys used for foraging (Herron et al. 1985). Although optimal habitat for ferruginous hawks does not exist in the project area, marginal nesting habitat may occur in the southernmost portion of the project area where isolated juniper trees are present (JBR 1998). No breeding activity has been observed in the project area.

The northern goshawk is an uncommon forest species that is a year-long resident, breeding in the mountains and wintering in the lower foothills and valleys (Herron et al. 1985). In Nevada, this species is generally associated with aspen stands and along perennial water sources (Herron et al. 1985). Although potential nesting habitat occurs in the Battle Mountain Range, no suitable habitat occurs in the project area.

The burrowing owl is ***known to breed throughout Nevada. The majority of the breeding population is known to migrate from northern Nevada during the winter months. However, observations of this owl have been recorded throughout Nevada during all months of the year (Herron et al. 1985).*** It is dependent on abandoned mammal burrows for nesting, typically foraging in open grasslands and sagebrush habitats. This owl feeds on insects and

small rodents, taking some reptiles, amphibians, and small birds (Terres 1991). Suitable habitat (i.e., shadscale and sagebrush communities) for this species is present in the project area. Burrowing owls, including one family group, were recorded in shadscale/cheatgrass habitat within the project area north of Ames Springs in 1997 (JBR 1998).

Sage grouse are native to the Battle Mountain area, occurring in upland shrub communities at the upper elevations. Breeding occurs on open leks (or strutting grounds) and nesting and brooding occurs in upland areas and meadows in proximity to water. During winter, sage grouse often occupy wind exposed areas where sagebrush is available (e.g., drainages, southern or western slopes, or exposed mesa and ridges). Surveys conducted in 1994 and 1995 recorded sage grouse in upland habitats and riparian areas of the Battle Mountain Range (BLM 1998). In 1997, the NDOW located five leks on ridges in the upper elevations of the Battle Mountain Range (JBR 1998). Historic lek sites previously identified by the Battle Mountain Band Council of Te-Moak Tribe of Western Shoshone and the Duck Valley Shoshone-Paiute Tribe as occurring within the project area were visited by the NDOW to determine activity. However, the NDOW was unable to verify that any of the sites were still active (BLM 1998). Because sage grouse rely heavily on small meadows and stream courses for brood rearing, the southern portion of Cottonwood and Trout Creeks within the project area may provide suitable brooding habitat (JBR 1998; NDOW 1999a). However, the incidence of use by brooding sage grouse hens along the intermittent portions of the streams occurring in the project area would be low due to the lack of summer flow and riparian vegetation.

#### 3.7.1.3 Mammals

The following background information on sensitive bats was summarized, using a variety of sources, including the *Bats of Nevada* (no date) and *General Life History of Nevada Bats* (no date). Potential presence in the project area is summarized from field surveys conducted in and near the project area (JBR 1998). Scientific names are provided in Table 3-18.

Several BLM sensitive bat species either occur or may occur in the project area. Federal and state agencies identified sensitive bat species, including the small-footed myotis, long-earred myotis, fringed myotis, long-legged myotis, Townsend's big-earred bat, and the spotted bat, as potentially occupying the appropriate habitat types in and near the project area. Rock outcrops, caves, mine shafts and adits, cliffs, trees, and buildings in the project region could provide day roost sites; caves and mines may be used for hibernacula, maternity roosts, or bachelor roosts. Surveys conducted in 1997 and 1998 identified bats using the Red Rock Adit in spring, summer, and early fall. Since no bats were observed during winter surveys, it is assumed that no hibernacula are currently used by resident bat species in the mine area. However, *Myotis* species are difficult to detect, and individual bats may be present during the winter period.

The small-footed myotis is a summer resident in Great Basin desert, shrub-steppe, and woodlands, with occasional reports in montane forests. This small bat inhabits rocky areas and forages for insects in clearings, near rocks, and over forests. It is known to hibernate in caves and mines, and summer roosts have been recorded in buildings and mines, under tree bark, and beneath rocks. Little is known of its reproductive biology (Arizona Game and Fish Department 1993; Colorado Division of Wildlife 1984; Fitzgerald et al. 1994). Small-footed myotis have been documented in the Battle Mountain area (BLM 1998). Guano deposition located in the Red Rock Adit located in the project area on September 9 and 10, 1998, suggested that the adit was used by a *Myotis* species (probably small-footed myotis) (JBR 1998).

The long-eared myotis is a summer resident in montane forests throughout Nevada, occupies mid-elevational piñon-juniper woodlands, and is dependent on perennial water sources within these woodlands. This species gleans insects (primarily small moths) over vegetation and open water while

foraging. Individuals typically day roost singly or in small groups (Colorado Division of Wildlife 1984; Fitzgerald et al. 1994). Roost sites encompass buildings, hollow trees, caves, mines, rocky crevices, and other underground openings. Little is known about this species' use of hibernacula, but caves and mine adits and shafts support wintering bats, in addition to providing habitat for breeding populations. Species' data relative to Nevada also are lacking. This bat species has been documented within the Battle Mountain area (BLM 1998). The Red Rock Adit may provide potential roost sites for this bat species; however, no individuals were observed during the 1997 field surveys (JBR 1998).

The fringed myotis is a summer resident in the Great Basin and has been reported in woodlands throughout the state. It occupies habitats ranging between desert scrub communities to higher elevation woodlands. In Nevada, piñon woodland is one of the most commonly used plant communities. This species gleans small insects (mainly moths) from foliage during foraging. Nursery colonies and hibernacula are often located in mines, caves, and buildings. Roosts may be in caves, rock crevices, mines, and buildings. Males typically roost singly (Colorado Division of Wildlife 1984). This species is susceptible to human disturbance, particularly during the breeding season (Arizona Game and Fish Department 1993). Parallel to the long-eared myotis, the fringed myotis was not observed during the field surveys, but potential roost sites could occur within the abandoned shafts and adits within the project area.

The long-legged myotis is a summer resident from Great Basin woodlands to montane forests. This species gleans insects above woodlands, over ponds, and along riparian corridors (Colorado Division of Wildlife 1984). Individuals typically day roost singly or in small groups in buildings, rock crevices, and loose tree bark. Night roosts and hibernacula are often in caves and mines (Colorado Division of Wildlife 1984; Warner and Czaplewski 1984). No long-legged myotis was observed during the 1997 field surveys; however, potential roost sites could occur within the abandoned shafts and adits within the project area (JBR 1998). This myotis has been documented within the Battle Mountain area (BLM 1998).

The Townsend's big-eared bat is a year-round resident in Nevada. This species prefers caves, mines, and buildings that maintain stable temperatures and air flow for nursery colonies, bachelor roosts, and hibernacula (Colorado Division of Wildlife 1984). The Townsend's big-eared bat occupies habitats ranging among desert, piñon-juniper, other coniferous forests, broadleaf or deciduous forests, shrublands, and grasslands. This species gleans insects from foliage and forages and roosts singly and in colonies (Colorado Division of Wildlife 1984). This bat is highly susceptible to disturbance during hibernation; mortalities may result from as few as one disturbance during this critical period (Fitzgerald et al. 1994). Townsend's big-eared bats were observed in the Red Rock Adit in 1997 and 1998. The adit is less than 100 feet long with a shaft near the portal. The shaft is approximately 40 feet deep. Approximately six Townsend's big-eared bats were observed in this adit during the fall of 1997. On June 5, 1998, another Townsend's big-eared bat (male) was observed in a state of torpor within the same adit. An additional Townsend's big-eared bat was observed on September 9 and 10, 1998 (JBR 1998).

The spotted bat is rare throughout the western U.S. Although limited data are currently available on this species, the spotted bat is thought to occupy cold deserts and submontane zones, using hibernacula that maintain a constant temperature from September to May rather than migrate (Dalton et al. 1990). It also is believed that this bat forages nocturnally for insects over open water, marshes, and open woodlands, (e.g., piñon-juniper). This species has been reported roosting in horizontal rock crevices in cliffs, along washes, or in rock outcrops (Wai-Ping and Fenton 1989). The upper elevations along the southern portion of the project area may provide suitable habitat for the spotted bat; however, no individuals were observed during the 1997 surveys (JBR 1998).

## 3.7.2 Environmental Consequences

### 3.7.2.1 Proposed Action

No sensitive plant populations are known to occur in the project vicinity. A sensitive plant habitat survey was conducted within the project vicinity in 1997 (JBR 1998). Potential habitat for sensitive plant species was not observed during the survey. Therefore, impacts to sensitive plant species are not anticipated, as a result of mine construction and operation.

The impact analysis for sensitive wildlife resources focuses on the species identified in Section 3.7.1, Affected Environment, addressing only the applicable project components for each species discussed.

No impacts to wintering or migrating bald eagles would be expected from the mine development. Birds may forage near the Humboldt River and in the surrounding foothills. No suitable roosting habitat occurs in the project area, and potential foraging activities within the upland habitats located within the proposed disturbance areas would be expected to be sporadic. However, no direct impacts to these areas would be anticipated from the proposed expansion and operation of the Marigold Mine. No indirect impacts to bald eagles would be expected from increased noise or human presence in the vicinity of the mine, based on the incidental use of the area by wintering or migrating birds.

No impacts to the peregrine falcon would be anticipated from the proposed project. No active eyries occur in or near the project area, no riparian habitat that may support falcon prey would be impacted by the proposed mine expansion, and migrating birds would be infrequent in the project vicinity.

Potential impacts to the golden eagle or Swainson's hawks from the proposed mine expansion would be limited to the incremental habitat loss and associated reduction in prey availability in and near the disturbance areas. No suitable nesting habitat for either of these species occurs in the immediate project area, and no indirect effects (e.g., water drawdown, harassment of breeding individuals) to possible nesting areas in the vicinity of the project would be anticipated. The incremental impacts to available foraging habitat and resident prey populations would not be considered significant, based on the relative low habitat value of the native plant communities (i.e., shadscale-cheatgrass and sagebrush-spiny hopsage) that would be removed by the expansion activities, as compared to the vegetative communities that are located farther south toward Battle Mountain. No direct or indirect impacts to Ames or Mud Springs have been identified. These spring complexes provide higher quality foraging areas than the habitats located within the immediate mine area, as apparent by the signs of perching raptors on rock outcrops located near the spring sites.

Ferruginous hawks may be indirectly impacted by the proposed mine expansion activities. Although no known nest sites have been documented in the project area, breeding birds may be present near the southern perimeter of the mine area, where the vegetation begins to transition into the higher elevational woodland communities. Since ferruginous hawks are highly susceptible to disturbance during the courtship and incubation periods, mine expansion activities, that would occur within 0.5 mile of an active nest site could result in indirect effects to breeding birds from increased noise levels and increased human presence. In the event that an occupied territory or active nest site were within direct line of sight of the proposed mine expansion activities, adult birds may abandon a breeding territory or nest site, if noise levels or human presence were to exceed this species' tolerance threshold. The environmental protection measures committed to by GMMC in Section 2.2.18.5, Wildlife and Livestock Protection, would aid in minimizing these potential effects to breeding ferruginous hawks, if present. The commitment to conduct breeding bird surveys within suitable native habitats prior to the initiation of construction and to develop applicable protection measures, if warranted, would protect individual nest

sites and breeding raptors in close proximity to the mine area. Residual impacts to this species would be the incremental habitat loss for foraging in and near the mine area from mine expansion.

No impacts to the northern goshawk would be anticipated from the proposed project. No direct or indirect impacts to breeding individuals would be anticipated, particularly since no impacts to surface water availability or associated riparian vegetation would occur from implementation of the proposed project. In addition, the vegetation in the project area is neither appropriate for goshawk nesting nor is it optimal for species' foraging.

Burrowing owls could be impacted by the proposed mine expansion, if present within or adjacent to the mine expansion area. Breeding birds were documented in the vicinity of the project (see Section 7.1.2), and the shrubland vegetation that would be disturbed by the proposed project is suitable for supporting breeding and foraging birds. Removal of a maximum of 671 acres of the shadscale-cheatgrass and sagebrush-spiny hopsage communities could directly affect the burrowing owl, if present. Surface disturbance would result in the loss of potential nesting habitat, and if the disturbance occurred during the breeding season, direct mortalities could occur to incubating adults or young owlets in the nest burrows. As discussed above for the ferruginous hawk, the environmental protection measures committed to by GMMC in Section 2.18.5, Wildlife and Livestock Protection, would aid in minimizing potential effects to breeding burrowing owls, if present in the project area. Habitat loss would be short-term (i.e., life of the mine) due to the relatively abundant shrubland habitats in the vicinity of the proposed project. Burrowing owls could inhabit the project area following mine reclamation (i.e., long term).

***No direct or indirect impacts to breeding or nesting sage grouse would be anticipated from the proposed project. This analysis is based on the lack of potentially suitable breeding and nesting habitat within the project area and the distances of known lek sites at the upper elevations of Battle Mountain. Potential impacts to sage grouse from project construction and operation would be limited to the incremental loss of marginally suitable brooding habitat in the southern portions of Cottonwood and Trout Creeks within the project area. However, as discussed in 3.7.1.2, the incidence of use by brooding sage grouse hens and young within the project area would be considered low, based on the intermittent flow of Cottonwood and Trout Creeks within the project area and the lack of riparian vegetation. Consequently, impacts to brooding sage grouse within the project area would be low.***

Of the seven sensitive bats identified for the proposed project, the small-footed myotis and the Townsend's big-eared bat have been documented as occurring in the project area and the long-legged myotis has been recorded in the vicinity of the project (i.e., Battle Mountain area) (see Section 3.7.1.3). Based on available foraging and roosting habitat, other bat species also may occur (see Table 3-18).

Based on the proposed project, the Red Rock Adit would be directly affected by mine expansion. Townsend's big-eared bats have been documented using this adit (see Section 3.7.1.3). However, the environmental protection measures committed to by GMMC in Section 2.2.18.5, Wildlife and Livestock Protection, would aid in minimizing potential long-term effects to roosting bats. GMMC has committed to developing and implementing specific protection measures for roosting bats by initiating a plan to incrementally exclude bats from the Red Rock Adit during the appropriate seasonal and diurnal/nocturnal period. This closure would allow the bats to leave the adit but not return, thereby forcing the individuals to other underground features in the region. Although this measure would prevent the direct loss by crushing of bats upon the initiation of construction activities, the Proposed Action would result in incremental habitat loss for resident bats and possible indirect mortalities of individuals that could not relocate. However, this effect would be anticipated to

be minimal, since the adit does not support large concentrations of bat species, the protection measure would protect individual bats from direct loss, and the availability of other potential roost sites along the Battle Mountain foothill region.

No other underground workings are known to occur within the project area. Therefore, no additional direct or indirect impacts to roosting bats (beyond those associated with the Red Rock Adit) would be anticipated from mine expansion activities.

#### 3.7.2.2 8-South Partial Pit Backfill Alternative

Overall impacts to sensitive species from implementation of the 8-South Partial Pit Backfill Alternative would parallel those described for the proposed project. Habitat disturbance for sensitive species under this alternative would be 85 acres less than for the proposed project.

#### 3.7.2.3 No Action Alternative

Under the No Action Alternative, the incremental habitat loss for the ferruginous hawk***, sage grouse, and*** burrowing owl would not occur. Incremental indirect impacts to roosting bats from mine expansion, increased noise, decreased air flow into hibernacula, or loss of roost site integrity would not occur. The exclusion of bats and loss of roosting habitat would not occur.

### 3.7.3 Cumulative Impacts

The incremental habitat loss within the cumulative assessment area would be parallel to that described for general wildlife in Section 3.6.3, Cumulative Impacts. The burrowing owl ***and sage grouse*** would be cumulatively affected by the past, present, and reasonably foreseeable future actions, based on overall habitat loss. However, it is impossible to quantify these impacts, since this species occurs sporadically throughout the region.

Other species that have likely been cumulatively affected by historic and ongoing mining activities would include nesting raptors. As the mine activities have expanded along Battle Mountain, breeding birds have moved farther from human disturbances, resulting in displacement and overall habitat fragmentation.

The presence of historic mining has likely improved the habitat for roosting bats. As the natural habitats have decreased for these sensitive bat species throughout the western U.S., bats have relocated into abandoned underground workings, using them for roost sites. However, potential cumulative impacts to bats would primarily involve additional exploration and mining activities that may result in loss of individuals, and the disturbance to roost sites either through direct impacts from noise, vibrations, and human presence or through indirect effects from future mining development.

### 3.7.4 Potential Mitigation and Monitoring

No additional mitigation measures have been developed for special status species, based on the environmental protection measures committed to by GMMC and outlined in Section 2.2.18.5, Wildlife and Livestock Protection.

### 3.7.5 Residual Adverse Impacts

No residual impacts would occur to Federally listed species identified for this project. Residual effects applicable to BLM state sensitive species would be limited to potential habitat loss for the burrowing owl ***and sage grouse***.

# 3.8 Range Resources

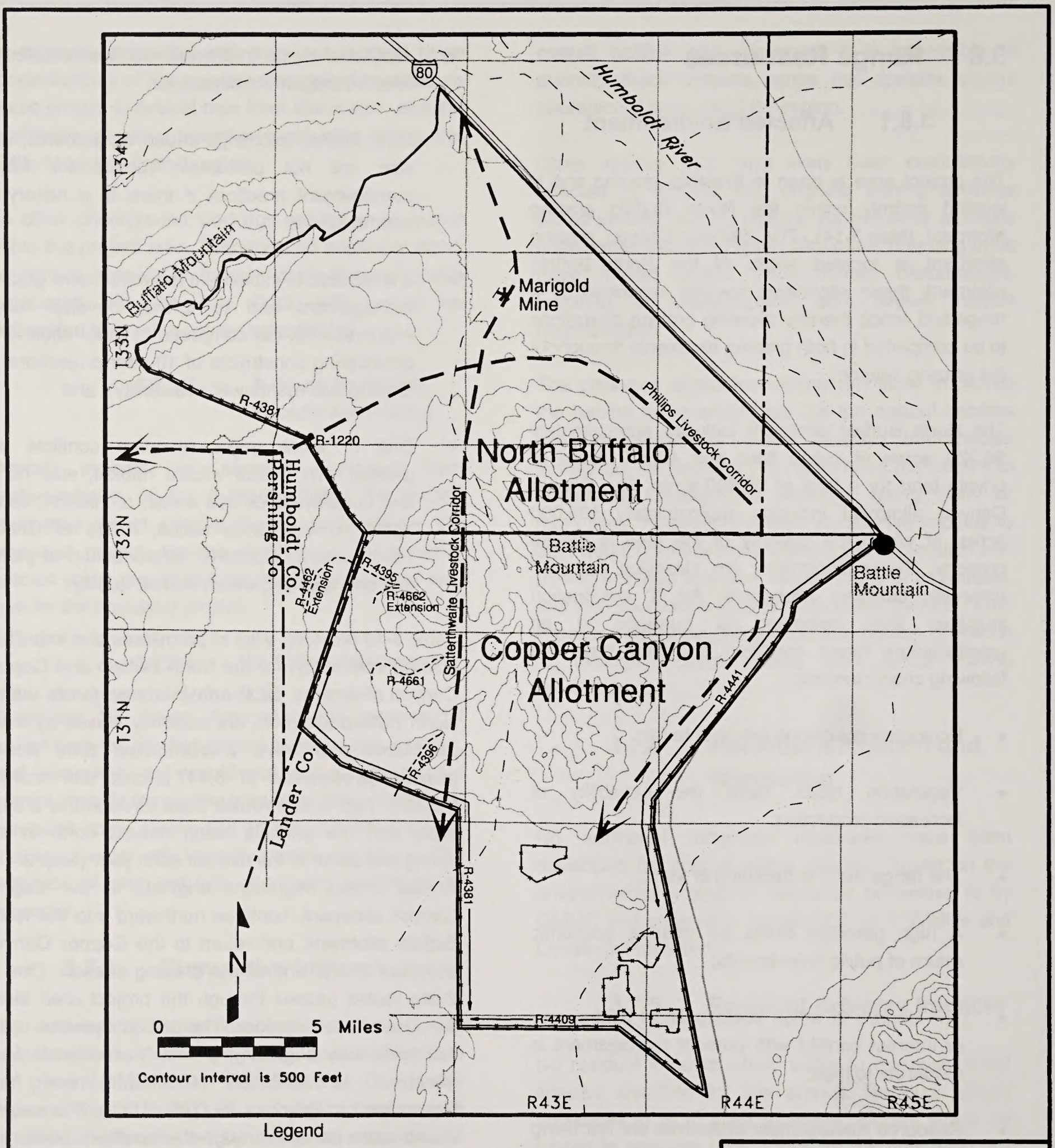
## 3.8.1 Affected Environment

The project area is open to livestock grazing and is located entirely within the North Buffalo grazing allotment (Map 3-14). The Copper Canyon grazing allotment is located south of the North Buffalo allotment; these allotments are not separated by a rangeland fence thereby allowing grazing operations to be completed in both grazing allotments throughout the grazing season.

The North Buffalo allotment includes approximately 56,320 acres of public land and 42,560 acres of private land for a total of 98,880 acres. The Copper Canyon allotment includes approximately 105,000 acres, of which the majority of the area is private property. These allotments are classified as a "I" (improve) category allotments. An "I" designation indicates that rangeland is currently in an unsatisfactory range condition and may have the following characteristics:

- Ecological conditions are poor to fair;
- Vegetation types have the capability of increased production;
- The range trend is declining or static;
- A high potential exists for positive economic return of public investments;
- The degree to which social/political controversy or interest conflict with present management is moderate to high;
- Resource management objectives are not being met (the allotment is in need of an allotment management plan or grazing system or major revisions are needed to an existing allotment management plan;
- Additional range improvements are required to meet management objectives;
- Land status, exchange-of-use agreements, and size are not prohibitive factors for future management practices if there is a history of prior trespass;
- It is feasible to implement more intensive grazing management and to further develop range improvements (as compared to other allotments considering constraints of 10-year projections of funding and manpower availability); and
- One or more major resource conflicts are present with critical wildlife habitat, wild horse and burro/livestock use areas, recreation, water rights, mining, lands action, Areas of Critical Environmental Concern, reintroduction of plants and animals, soil, water, and air quality.

Table 3-19 provides a list of permittees and important grazing information for the North Buffalo and Copper Canyon allotments. ***BLM-administered lands within*** North Buffalo allotment ***are*** currently leased by three permittees ***and have a combined total active grazing preference*** of 3,447 animal unit months (AUMs). Two sheep routes pass through the project area, with the animals being moved north in the spring and south in the late fall each year (Map 3-14). Annual sheep migrations originate in the Copper Canyon allotment, continue northward into the North Buffalo allotment, and return to the Copper Canyon allotment at the end of the grazing season. One of these routes passes through the project area along the Trout Creek corridor. The sheep operator using this route has a grazing permit that extends from March 1 to April 30 (405 AUMs) and from November 1 to February 28 (789 AUMs). The second sheep route passes through the southern portion of the project area, less than one mile north of Mud Spring. The operator using this route has a grazing permit that extends from March 1 to March 31 (431 AUMs) and from November 1 to February 28




Legend

- County Boundary
- Interstate 80
- Road
- Stream or Intermittent Stream
- City
- Allotment Boundary
- Road
- Water Pipeline
- Well
- Livestock Corridor

**Marigold Mine**

**Map 3-14**

**Grazing Allotments and Range Improvements**

**Table 3-19**
**Livestock Grazing Permits for the North Buffalo and Copper Canyon Allotments**

| Grazing Allotment | Permittee | Kind of Livestock | Numbers of Livestock | Grazing Period and Dates | Percent on Public Land | Active Preference (AUMs) |
|---|---|---|---|---|---|---|
| North Buffalo | Badger Ranch | Cattle | 255 | 3/1 – 2/28 | 5 | 153 |
| | Ellison Ranching | Sheep | 1,009 | 3/1 – 4/30 | 100 | 405 |
| | | Sheep | 1,000 | 11/1 – 2/28 | 100 | 789 |
| | Agri-Beef Company | Sheep | 2,115 | 3/1 – 3/31 | 100 | 431 |
| | | | 2,115 | 11/1 – 2/28 | 100 | 1,669 |
| **Subtotal** | | | | | | 3,447 |
| Copper Canyon | Ellison Ranching Company | Sheep | 300 | 3/1 – 4/30 | 100 | 120 |
| | | Sheep | 335 | 11/1 – 2/28 | 100 | 264 |
| | Badger Ranch[1] | Cattle | 490 | 3/1 – 2/28 | 61 | 3,587 |
| | Chiara Ranch[1] | Cattle | 30 | 11/1 – 2/28 | 42 | 50 |
| | Agri-Beef Company | Sheep | 1,009 | 3/1 – 3/31 | 100 | 206 |
| | | Sheep | 1,009 | 11/1 – 2/28 | 100 | 796 |
| **Subtotal** | | | | | | 5,023 |
| **TOTAL** | | | | | | 8,470 |

[1]Although there are separate ranches, the owner is common to both.

Source: JBR 1997a, 1999a.

(1,669 AUMs). A third operator has a grazing permit to utilize 153 AUMs for yearlong cattle grazing within the project vicinity.

The Copper Canyon allotment involves four grazing permits held by three permittees. The Ellison Ranching Company, a sheep operation, holds one permit with an active preference for 384 AUMs, 100 percent of which is on public land. The Badger Ranch operations include approximately 61 percent public rangeland with an active grazing preference of 3,587 AUMs. The Chiara Ranch operations include approximately 42 percent public rangeland with an active grazing preference of 50 AUMs. The Agri-Beef Company operations occur entirely on public rangeland with an active grazing preference of 1,002 AUMs.

The North Buffalo and Copper Canyon allotments include 12 range improvements, none of which are located within the project area (Map 3-14). A description of these improvements is provided in Table 3-20. The majority of these improvements are perimeter fencing and spring/water development pipelines in the western portion of the Copper Canyon allotment. The remaining improvements are cattleguards.

Two prominent range sites occur in the project area including the shallow calcareous loam (8 to 10 inches of precipitation per year) and loamy (5 to 8 inches of

**Table 3-20**
**Range Improvements for the North Buffalo and Copper Canyon Allotments**

| Grazing Allotment | Improvement Number | Name | Location |
|---|---|---|---|
| North Buffalo | R-4381 | North Buffalo Fence | Township 33 North, Range 42 East, Section 32 |
| | R-1220 | Stock well | Township 33 North, Range 42 East, Section 32 |
| Copper Canyon | 594381 | Copper Canyon Fence | Township 31 North, Range 42 East, Section 20 |
| | 594395 | Mill Spring Improvement and Pipeline | Township 32 North, Range 42 East, Section 27 |
| | 594396 | Rocky Spring Improvement and Pipeline | Township 31 North, Range 42 East, Section 24 |
| | 594409 | Harry Canyon Division Fence | Township 29 North, Range 43 East, Section 9 |
| | 594441 | Shoshone Highway 8A Fence | Township 30 North, Range 44 East, Section 5 |
| | 594661 | Timber Canyon Pipeline | Township 31 North, Range 42 East, Section 1 |
| | 594662 | Mill Creek Pipeline Extension | Township 32 North, Range 42 East, Section 27 |
| | 594384 | Copper Canyon Cattleguard | Township 30 North, Range 42 East, Section 1 |
| | 594892 | State Highway 305 Fence | Township 31 North, Range 44 East, Section 24 |
| | 594893 | State Highway 305 Cattleguards | Township 31 North, Range 44 East, Section 24 |

Source: JBR 1997a.

precipitation per year) sites. Dominant species associated with the shallow calcareous loam site include black sagebrush, Thurber needlegrass, and Indian ricegrass. The average annual forage production is 350 pounds per acre per year. The loamy range site occurs at lower elevations, with common species including shadscale, bud sagebrush, bottlebrush squirreltail, and Indian ricegrass. Average annual forage production is 450 pounds per acre per year.

A three-strand barbed wire fence currently exists along the existing permit boundary, which excludes livestock from grazing within the mine area. Natural surface water sources, including springs and intermittent creeks, are available for use by grazing livestock in the project vicinity (see Section 3.1.1.2, Surface Water). Mud Spring is located less than 0.5 mile south of the proposed permit boundary and is a perennial water source utilized by grazing livestock on a seasonal basis. This spring was developed during the 1970s to improve water supply and quality. However, the improvements that were made to the spring have substantially deteriorated since that time as a result of heavy use by livestock. Ames Spring, which is a perennial spring, is located less than 0.1 mile south of the proposed permit boundary and also is utilized as a water source by grazing livestock on a seasonal basis. Perennial reaches of Cottonwood and Trout creeks, which are located south of the project area, are also used as water sources by grazing livestock.

## 3.8.2 Environmental Consequences

### 3.8.2.1 Proposed Action

Impacts to rangeland resources resulting from the Proposed Action include: 1) temporary loss of AUMs from the construction of a range perimeter fence, 2) permanent loss of AUMs due to the direct loss of vegetation within the pit area, and 3) interference with range management activities.

The existing perimeter fence constructed along the current permit boundary has excluded approximately 2,638 acres of rangeland from livestock grazing. A new perimeter fence would be constructed along the proposed permit boundary, which would include an additional 5,762 acres of rangeland. Therefore, an additional 5,762 acres of vegetation would be temporarily unavailable for livestock grazing during mine development and operation. The average stocking rate for this allotment is 20 acres/AUM. Therefore, the exclusion of livestock from 5,762 acres of rangeland forage would result in the temporary loss of 288 AUMs, which would reduce the active grazing preference within the North Buffalo allotment to 3,159 AUMs for the life of the project. The loss of 288 AUMs represents less than 8 percent of the active grazing preference. A permanent loss of 131 acres of rangeland or 6 AUMs would result from pit expansion associated with the Proposed Action and the construction of a berm along the pit perimeter after mine closure and reclamation. Successful reclamation of and increased forage productivity associated with the waste rock dumps may partially compensate the loss of 6 AUMs.

Construction of the range perimeter fence may interfere with some seasonal movements of livestock. However, this minor interference would not restrict access to adjacent rangeland within the allotment during the life of the project. Ames and Mud Springs, which are used as livestock watering sources, would ***remain available to livestock and would not be affected by the Proposed Action***.

### 3.8.2.2 8-South Partial Pit Backfill Alternative

The proposed perimeter fence area for this Alternative would encompass the same additional acreage (5,762 acres) as for the Proposed Action. The temporary and permanent loss of AUMs would be the same as described for the Proposed Action.

### 3.8.2.3 No Action Alternative

Under the No Action Alternative, additional impacts to range resources would not occur from development and operation of the Proposed Action. Presently permitted mine and mineral exploration projects associated with the Marigold Mine has resulted in the exclusion of 2,638 acres of rangeland. This exclusion has resulted in the temporary loss of 132 AUMs, based on a average stocking rate of 20 acres per AUM.

## 3.8.3 Cumulative Impacts

The cumulative assessment area for range resources encompasses approximately 203,000-acre area including the North Buffalo and Copper Canyon allotments (Map 3-12). Past and present disturbances within these grazing allotments include approximately 12,393 acres of rangeland disturbed during previous mining and other development activities (i.e., miscellaneous mining activities). Mine development and operation activities associated with the proposed project would result in the disturbance or removal of 717 acres of rangeland. Reasonably foreseeable future projects identified in the cumulative assessment area would disturb approximately 6,325 acres of rangeland. Therefore, a total of 19,435 acres of rangeland would be disturbed or removed by past, present, and proposed activities. These disturbances have resulted in an estimated temporary loss of 972 AUMs and permanent loss of 97 AUMs based on an average stocking rate of 20 acres per AUM. It is assumed that the majority (i.e., 90 percent) of the mine-related surface disturbance would be reclaimed after mine operations cease.

### 3.8.4 Potential Mitigation and Monitoring

No mitigation measures for range resources are recommended.

### 3.8.5 Residual Adverse Impacts

Residual impacts of the Proposed Action for range resources would include the permanent loss of 6 AUMs. This total represents less than 1 percent of the total AUMs for the North Buffalo allotment.

# 3.9 Land Use and Access

## 3.9.1 Affected Environment

### 3.9.1.1 Land Use

Lands administered by the BLM comprise the majority of public lands in Humboldt County and account for approximately 70 percent of the county's land base (State of Nevada 1996). Private lands comprise approximately 20 percent of Humboldt County and generally are interspersed with public lands in a checkerboard pattern for a distance of 20 to 25 miles on either side of the Humboldt River. This land ownership pattern resulted from Congress deeding alternate sections of land (each section being 1 square mile) to the Central Pacific Railroad Company, which constructed the Trans-Continental Railroad through Nevada in the late 1860s. The remaining 10 percent consists of state, county, and other Federal lands. Surface ownership in the project area is shown in Map 2-1.

Public lands under BLM jurisdiction are managed for the multiple uses of range, forestry, watershed, mineral extraction, recreation, wilderness, and wildlife habitat. The project area is located within the BLM's Winnemucca District. The BLM's Sonoma-Gerlach Management Framework Plan (BLM 1982) indicates that land use within the project area is open for mineral exploration and development. One of the objectives in the plan is to make public lands and Federally owned minerals available for exploration and development of mineral and material commodities.

The project area is zoned M-3 (Open Land Use District) by Humboldt County for open space and provides a wide variety of rural land uses. Mineral extraction industries are recognized as an accepted use within this land classification. Mining is a principal permitted use within this zoning district and must comply with Article 10 of the Humboldt County Zoning Ordinance, which requires a Special Use Permit for operations located on private lands.

Land use within the project area primarily consists of mineral exploration and development, livestock grazing, and dispersed recreational use. GMMC has operated the Marigold Mine since 1988. The existing permit boundary encompasses approximately 2,688 acres of public and private lands, of which 1,098 acres are managed by the BLM. There are no State-administered lands within the GMMC property boundary; however, a section (approximately 640 acres) of private land is owned by the University of Nevada, Reno.

The project area is located within the 98,880-acre North Buffalo Grazing Allotment that includes both private and public lands. See Section 3.8, Range Resources, for a discussion of livestock grazing. Section 3.10, Recreation, contains a discussion of dispersed recreational use in the project area.

There are several other gold mines located in proximity to the project area. The Trenton Canyon Mine is located immediately to the south of the project area. The active Lone Tree Mine is located approximately 8 miles northwest of the Marigold Mine. The Sierra Pacific North Valmy Power Station is another major industrial development in the project vicinity; it is located approximately 5 miles to the north.

There are no residences within the project area; the nearest residences are located approximately 3 miles to the north in the town of Valmy.

### 3.9.1.2 Rights-of-Way

Interstate 80 lies to the east of the project area. A 120-kV transmission line passes through the project area. Other ROWs near the project area include a water supply line that serves the mine site. Map 3-15 depicts existing ROWs in and near the project area, and Table 3-21 provides additional information on the ROWs.

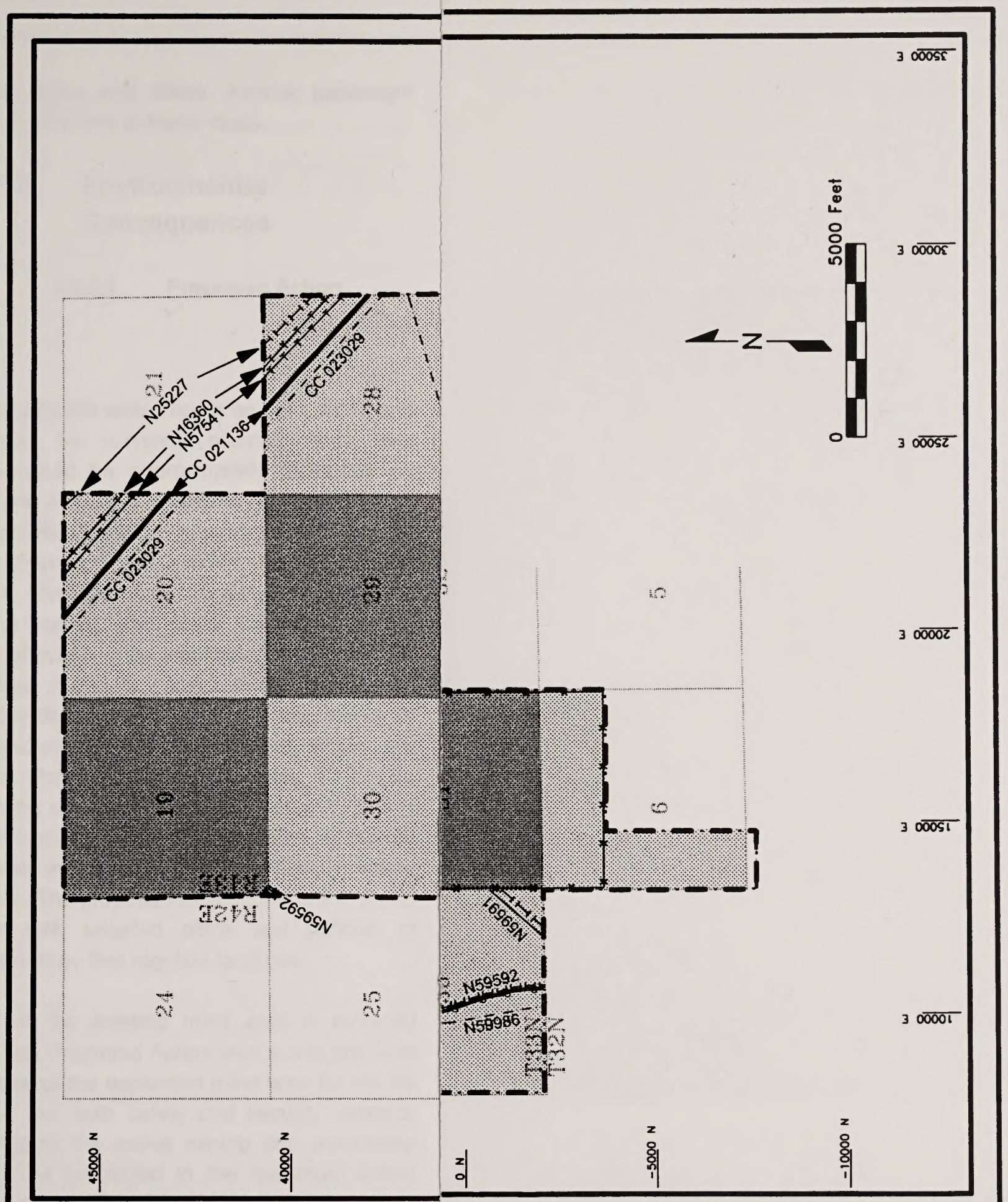
**Table 3-21**
**Existing Rights-of-Way Within the Project Area**

| Serial Number | Type of Land Use | ROW Holder | Location | Width |
|---|---|---|---|---|
| N-25227 | N. Valmy Station Power Line (23kV), Water Pipeline (18") and Patrol Road | Sierra Pacific Power Company | T34N, R43E, Sections 20 and 28 | 30 feet |
| N-16360 | Telephone/Telegraph Line | Nevada Bell | T34N, R43E, Sections 20 and 28 | 10 feet |
| N-57541 | Telephone/Telegraph Line | Nevada Bell | T34N, R43E, Sections 20 and 28 | 20 feet |
| CC-021136 | Interstate 80 | Nevada Department of Transportation | T34N, R43E, Sections 20 and 28 | 400 feet |
| CC-023029 | Power line | Sierra Pacific Power Company | T34N, R43E, Sections 20 and 28 | 100 feet |
| Nev-066891 | Power line (120kV) | Sierra Pacific Power Company | T34N, R42E, Section 36; T33N, R43E, Sections 4 and 10; T34N, R43E, Section 32 | 75 feet |
| Nev-058529 | Power line (7.2kV) | Sierra Pacific Power Company | T34N, R43E, Sections 28 and 32 | 40 feet |
| N-59986 | Power line (24.9kV) | Santa Fe Pacific | T33N, R42E, Sections 12, 24, and 36; T34N, R42E, Section 36 | 30 feet |
| N-59591 | Water Pipeline (6") and Patrol Road | Santa Fe Pacific | T33N, R42E, Section 36 T33N, R43E, Section 30 | Variable |
| N-59592 | Water pipeline, road, and communication cable | Santa Fe Pacific | T33N, R43E, Section 6; ***T33N, R42E, Sections 24 and 36; T34N, R42E, Section 36; T33N, R43E, Section 18; T34N, R43E, Section 30*** | 100 feet |

### 3.9.1.3 Access

Access to the project area is provided via I-80 and the unpaved Buffalo Valley Road, which is maintained by Humboldt County. A security gate at the entrance to the mine prevents unauthorized public access to the mine site. I-80 is the primary east-west highway in Nevada and connects Winnemucca, Battle Mountain, and destinations farther east with Reno and destinations farther west. The Buffalo Valley Road also provides access to the Trenton Canyon Mine and public and private lands farther to the southwest.

Traffic volumes on I-80 near the Valmy interchange average 5,780 vehicles per day (Nevada Department of Transportation 1996). No data exist for traffic volumes on Buffalo Valley Road, which provides access to the Marigold Mine. The Southern Pacific and Union Pacific railroads, which roughly parallel I-80 east of the project area, provide freight service to




# Marigold Mine

## Map 3-15

## Existing Rights-of-Way Within the Project Area

**Table 3-21**
**Existing Rights-of-Way Within the Project Area**

| Serial Number | Type of Land Use | ROW Holder | Location | Width |
|---|---|---|---|---|
| N-25227 | N. Valmy Station Power Line (23kV), Water Pipeline (18") and Patrol Road | Sierra Pacific Power Company | T34N, R43E, Sections 20 and 28 | 30 feet |
| N-16360 | Telephone/Telegraph Line | Nevada Bell | T34N, R43E, Sections 20 and 28 | 10 feet |
| N-57541 | Telephone/Telegraph Line | Nevada Bell | T34N, R43E, Sections 20 and 28 | 20 feet |
| CC-021136 | Interstate 80 | Nevada Department of Transportation | T34N, R43E, Sections 20 and 28 | 400 feet |
| CC-023029 | Power line | Sierra Pacific Power Company | T34N, R43E, Sections 20 and 28 | 100 feet |
| Nev-066891 | Power line (120kV) | Sierra Pacific Power Company | T34N, R42E, Section 36; T33N, R43E, Sections 4 and 10; T34N, R43E, Section 32 | 75 feet |
| Nev-058529 | Power line (7.2kV) | Sierra Pacific Power Company | T34N, R43E, Sections 28 and 32 | 40 feet |
| N-59986 | Power line (24.9kV) | Santa Fe Pacific | T33N, R42E, Sections 12, 24, and 36; T34N, R42E, Section 36 | 30 feet |
| N-59591 | Water Pipeline (6") and Patrol Road | Santa Fe Pacific | T33N, R42E, Section 36 T33N, R43E, Section 30 | Variable |
| N-59592 | Water pipeline, road, and communication cable | Santa Fe Pacific | T33N, R43E, Section 6; ***T33N, R42E, Sections 24 and 36; T34N, R42E, Section 36; T33N, R43E, Section 18; T34N, R43E, Section 30*** | 100 feet |

#### 3.9.1.3 Access

Access to the project area is provided via I-80 and the unpaved Buffalo Valley Road, which is maintained by Humboldt County. A security gate at the entrance to the mine prevents unauthorized public access to the mine site. I-80 is the primary east-west highway in Nevada and connects Winnemucca, Battle Mountain, and destinations farther east with Reno and destinations farther west. The Buffalo Valley Road also provides access to the Trenton Canyon Mine and public and private lands farther to the southwest.

Traffic volumes on I-80 near the Valmy interchange average 5,780 vehicles per day (Nevada Department of Transportation 1996). No data exist for traffic volumes on Buffalo Valley Road, which provides access to the Marigold Mine. The Southern Pacific and Union Pacific railroads, which roughly parallel I-80 east of the project area, provide freight service to

# Marigold Mine

## Map 3-15

## Existing Rights-of-Way Within the Project Area

Winnemucca, Elko, and Reno. Amtrak passenger service also is provided at these stops.

## 3.9.2 Environmental Consequences

### 3.9.2.1 Proposed Action

**Land Use**

The Proposed Action would occur on both public and private lands. As currently planned, total new disturbance would be approximately 255 acres on public land and 462 acres on private land, resulting in a total project disturbance of approximately 717 acres (Table 2-2). Expansion and development of the pits, waste rock dumps, and construction of haul roads/access roads, and creek diversions would require use of public lands administered by the BLM. The Proposed Action is consistent with plans and policies of the BLM that recognize the importance of mineral exploration and development within the project area. Proposed mining activities on private lands would be consistent with the Humboldt County Zoning Ordinance provided that expansion on private lands complies with Special Use Permit requirements of the County. The proposed project, therefore, would not conflict with adopted plans and policies of government entities that regulate land use.

Public use of the existing mine area is currently prohibited. The Proposed Action also would preclude any public use of the expanded mine area for the life of the mine. For both safety and security reasons, public access to the active mining and processing areas would be precluded to the maximum extent permitted by law during the life of mining. The area of operations would be fenced, as described in Section 2.2.14, Security and Fencing, and would not be accessible to the general public. Consequently, dispersed recreational use of lands within the proposed project area would be prohibited (Section 3.10.2.1 of Recreation).

The Proposed Action would be compatible with existing land use patterns and, therefore, would not result in adverse impacts to existing land uses. The proposed expansion would exclude grazing on approximately 5,762 acres of currently available rangeland in the North Buffalo Grazing Allotment as a result of the construction of the perimeter fence. The projected loss of animal unit months during mine operations and after the reclamation period is not expected to adversely affect the lessee (Section 3.8.2.1 of Range Resources).

**Rights-of-Way**

Mine expansion has the potential to change or modify administrative land use ROWs within the project area. All ROWs necessary to support operations at the Marigold Mine are in place and current. Construction of the 5-North Pit may necessitate realignment of the 120 kV power line operated by SPPCo. However, this realignment would occur on private land (Section 5, T33N, R43E) and would not affect ROWs maintained by the BLM on public lands. The realignment would be performed in coordination with SPPCo. Mine expansion would not affect major ROW easements, such as I-80.

**Access**

The proposed project is not expected to have an adverse impact on access to public and private lands in the study area. Construction of the 5-North Pit, Waste Rock Dump, and Heap Leach Pad would require realignment of the Buffalo Valley Road. The length of the reroute would be approximately 2.1 miles. GMMC would construct the new road on public and private lands immediately north and west of these facilities to ensure continued public access (Map 2-2). Construction of the new road segment would occur prior to the construction of mine facilities, during which time access would continue to be provided on the existing road, in order to allow uninterrupted public access to Buffalo Valley, Trout Creek, and the Trenton Canyon Mine. Prior to construction of the Buffalo Valley Road realignment, GMMC would obtain a right-of-way permit from the BLM for the portion of the road segment located on public land. GMMC would be responsible for

maintenance activities for the realigned segment during mine operations and reclamation. After mine closure, GMMC would transfer the ROW to another responsible party, such as Humboldt County, BLM, or others interested in maintaining the public access. If the ROW cannot be transferred, GMMC would consider reclaiming the realigned portion of the road.

Average daily traffic volumes on local roadways, including I-80, are not expected to change significantly from current levels as a result of the proposed project. The expected increase in the mine work force (and associated daily community trips) would comprise only a small fraction of average daily traffic on the interstate. Further, the proposed project is not expected to result in a significant increase in truck traffic to or from the mine.

The closure, abandonment, and reclamation of the mine area would return disturbed lands to their pre-mining land use as rangeland, wildlife habitat, and dispersed recreation. Except for the open pits, all other areas would be reshaped and revegetated, and public access would be established. A combination of safety berms, fencing, and warning signs would be placed around the pit to prevent public access.

#### 3.9.2.2 8-South Partial Pit Backfill Alternative

The 8-South Partial Pit Backfill Alternative would result in less disturbance than the Proposed Action. Specifically, this alternative would eliminate the need to expand the 8-North Waste Rock Dump, which under the Proposed Action would disturb 85 acres (69 acres of this disturbance would be on public lands). Consequently, total disturbance under this alternative would affect 632 acres, of which 186 acres would be located on public lands.

The 8-South Partial Pit Backfill Alternative would result in the removal of approximately 5,762 acres of currently available rangeland in the North Buffalo Grazing Allotment. Impacts to the lessee from the projected loss in AUMs is described in Section 3.8.2.2 of Range Resources.

#### 3.9.2.3 No Action Alternative

Under the No Action Alternative, additional disturbance to lands within the project area would not occur. Access to undeveloped portions of the project area would be preserved, and the existing land uses would be maintained, including grazing on the North Buffalo Allotment.

### 3.9.3 Cumulative Impacts

No cumulative impacts to land use and access were identified as a result of the Proposed Action. Consequently, the Proposed Action would not contribute to cumulative land use and access effects. Cumulative impacts to livestock grazing are discussed in Section 3.8.3, Cumulative Impacts for Range Resources, and cumulative impacts to recreational resources are described in Section 3.10.3, Cumulative Impacts for Recreation.

### 3.9.4 Potential Mitigation and Monitoring

No land use or access impacts would require monitoring or mitigation measures.

### 3.9.5 Residual Adverse Impacts

Residual impacts to land use relate primarily to the success of the reclamation efforts. If, upon project completion, the affected land area were reclaimed such that former land uses could be reinstated, residual adverse effects would be minimal. However, if reclamation were unsuccessful, residual land use effects could occur.

# 3.10 Recreation

## 3.10.1 Affected Environment

No developed recreational facilities exist within proximity to the project area. The nearest developed facility is the Mill Creek Recreation Area, which is maintained by the BLM and located 24 miles south of Battle Mountain. The Mill Creek Recreation Area contains picnic facilities, camp sites, and restrooms. Other recreational opportunities include fishing, hiking, mountain biking, and geological sightseeing.

Dispersed outdoor recreation is the predominant type of recreation in the Winnemucca District. The BLM does not maintain current recreational use data for the pubic lands in the study area. Recreational use within the proposed expanded permit boundary is limited and includes off-road vehicle use and hunting. Dispersed recreational activities that occur in the mine vicinity include hunting of small game and deer, and fishing within Trout Creek. However, use of Trout Creek by anglers is extremely limited. Data maintained by NDOW indicate that angler use declined dramatically in the early 1980s (from a high of 240 anglers in 1980) to no use by 1992. This trend was largely a result of a 7-year drought that ended by 1992. The fishery on that segment of Trout Creek used by anglers was depleted; the NDOW does not stock Trout Creek (French 1999). Thus, data for the years 1992 through 1998 indicate no angler use of Trout Creek. Data on angler use are not maintained by NDOW for the nearby Cottonwood Creek.

Limited hunting occurs in the project area. The only big game species in the vicinity is mule deer. Other game species such as chukar, California quail, and mourning dove occur throughout the area as well. Data are not available to characterize hunter use in the project area or vicinity. Hunting for big game is regulated through a quota system established by NDOW. The quota system is oversubscribed each year for deer tags because demand far exceeds supply.

No designated wilderness areas or wild and scenic rivers exist within 60 miles of the project area. The closest Wilderness Study Area (WSA) is the China Mountain WSA, located approximately 18 miles southwest of the project area.

## 3.10.2 Environmental Consequences

### 3.10.2.1 Proposed Action

No parks, concentrated recreational use areas, designated wilderness areas, WSAs, or special recreation management areas would be directly impacted by the proposed mine expansion. The proposed expansion would withdraw additional lands previously available for dispersed recreationists during construction, operation, and reclamation activities. Recreational activities, such as hunting, would be prohibited within the mine site during the life of the project. Off-highway vehicle use would continue to be restricted at the mine site. Overall, the displacement of dispersed recreationists would be a minimal adverse impact since existing recreational use in the project area is extremely light, and the area has other abundant public, open-space lands available for dispersed recreational opportunities. Public access would not be restricted on public roads near the mine site. Although no specific recreational use data for public lands directly affected by the proposed project are available, the number of dispersed recreationists affected is expected to be minimal, and their displacement would not create overuse of other areas or degradation of the resource.

Hunting opportunities would not be affected by the proposed expansion. Impacts to mule deer populations within the project vicinity are expected to be minimal with the proposed expansion, while impacts to the availability of upland game species from hunting in the region is expected to be minimal (Section 3.6, Wildlife and Fisheries Resources). Consequently, a minor reduction to hunting opportunities in the project vicinity is expected. Given

the diversity of public lands available locally for hunting, this impact would not be considered adverse.

The proposed expansion would not affect public access to Trout Creek. Existing access routes would remain open, even though the expanded permit boundary would encompass the Buffalo Valley Road. As described in Section 3.9.2.1 of Land Use and Access, access along the Buffalo Valley Road would be modified from construction of mine-related facilities; however, GMMC would reroute the access road to provide continued public access prior to removing the existing road alignment.

Developed recreational facilities within the region, such as the Mill Creek Recreation Area, are not expected to be adversely impacted by the increase in the construction and operation work force required for mine expansion. This is because developed recreational facilities in the region have the capacity to absorb the extra demand that could be placed on them, as a result of the increased work force.

The closure, abandonment, and reclamation of the mine area would return public lands to their pre-mining land use as rangeland, wildlife habitat, and dispersed recreation. Except for the mine pits, all other facilities would be revegetated and made available for public access. Thus, the potential exists for hunting opportunities on the mine site following mine closure and reclamation.

#### 3.10.2.2 8-South Partial Pit Backfill Alternative

This alternative would generate impacts to recreational resources identical to those described for the Proposed Action.

#### 3.10.2.3 No Action Alternative

Under the No Action Alternative, disturbance associated with the proposed project would not occur, and existing dispersed recreational opportunities on public lands within the mine area (hunting and off-road vehicle use) would continue to be available.

### 3.10.3 Cumulative Impacts

Cumulative development has adversely impacted big game populations as a result of habitat displacement as well as additional road construction and the associated increased public access, which is considered beneficial to hunting opportunities. Cumulative impacts to game populations are described in Section 3.6.3 of Wildlife and Fisheries Resources. The overall cumulative impact to recreational resources from past, present, and reasonably foreseeable future actions would be considered minimal because abundant public open space lands currently do, and would, remain available for dispersed recreational opportunities.

### 3.10.4 Potential Mitigation and Monitoring

Since no adverse impacts to recreational resources have been identified for the Proposed Action or 8-South Partial Pit Backfill Alternative, no mitigation or monitoring is recommended.

### 3.10.5 Residual Adverse Impacts

No residual adverse impacts are expected to result from implementation of the Proposed Action or 8-South Partial Pit Backfill Alternative.

# 3.11 Aesthetics

## 3.11.1 Affected Environment

### 3.11.1.1 Visual Resources

The BLM initiated visual resource management (VRM) to manage the quality of the landscape by minimizing impacts to visual resources resulting from development activities, while maintaining the effectiveness of all BLM resource programs. In determining VRM class designations, the inventory process considers the scenic value of the landscape, viewer sensitivity to the scenery, and the distance of the viewer to the subject landscape. These management classes identify various permissible levels of landscape alteration, while protecting the overall visual quality of the region (BLM 1986). Management classes are broken down into four levels (Classes I to IV), with Class I designated as most protective of the visual resources. The objectives of these classes vary from very limited management activity to activity that allows major landscape modifications (Table 3-22). Short-term (3 to 5 years) exceptions are allowed if VRM objectives are met in the long term (10 to 20 years).

The portion of the project area located within 3 miles of I-80 is located within a VRM Class III visual management landscape (Table 3-22). The remainder of the project area lies within a VRM Class IV area. These designations were created prior to the onset of mining activities at the site in 1988, and reflect the fact that the area is visible to thousands of motorists on I-80 each day.

Landscape character type is a unit of physiographic area having common characteristics of land forms, rock formations, water forms, and vegetation patterns. The study area and existing Marigold Mine are located in the Great Basin region of the Basin and Range Physiographic Province. Basin and Range landscapes in northern Nevada typically are characterized by broad, open basins bounded by isolated mountain ranges covered by piñon-juniper vegetation. This type of landscape allows for long viewing distances. The project area is located on the piedmont slopes of Battle Mountain and slopes toward the Humboldt River to the east. Elevation within the project area ranges from approximately 4,600 feet to 5,800 feet (amsl).

Battle Mountain forms the backdrop for views of the mine site from I-80 and the California Emigrant National Historic Trail. The squat geometric shapes of the existing heap leach facility and active waste rock dumps contrast strongly with natural forms of the foothills, which tend to be more rolling to rugged. Vegetation in the area, which consists mainly of sagebrush/shadscale and grasses, provides relatively uniform coverage on the alluvial slopes near the mine area, while shrub coverage on the slopes of Battle Mountain is irregular and patchy.

At present, the most dominant man-made features within the study area include I-80, the Valmy rest stop, the Valmy Power Station, and waste rock dumps associated with the Lone Tree Mine, which are readily apparent from I-80 near the Stonehouse Interchange. The Marigold Mine is viewed at a distance of at least 2.5 miles by motorists on I-80 and is not apparent to the casual observer. Upon close inspection, the squat geometric forms of the existing 8-South Waste Rock Dump and the tailings dam provide only minor contrast to the juniper-studded foothills of Battle Mountain. These facilities essentially screen views of other mine elements. Regional haze or low-lying clouds often obscure views of Battle Mountain throughout the year.

The objectives of the visual resources investigation are to identify and describe important visual resources that could be affected by the proposed mine expansion and related facilities. Important visual resources are defined for this study from key observation points (KOPs) where the maintenance of the surrounding visual environment is important to people's enjoyment of an area. Visual resources include landscapes in which viewers may travel, use for recreation, or reside where existing views may

**Table 3-22**
**BLM Visual Resource Management Classes**

| Class | Description |
|---|---|
| I | The objective of this class is to preserve the existing character of the landscape. This class provides for natural ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention. |
| II | The objective of this class is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color and texture found in the predominant natural features of the characteristic landscape. |
| III | The objective of this class is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape. |
| IV | The objective of this class is to provide for management activities, which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements. |

Source: BLM 1986.

potentially be affected by the proposed expansion or ancillary facilities.

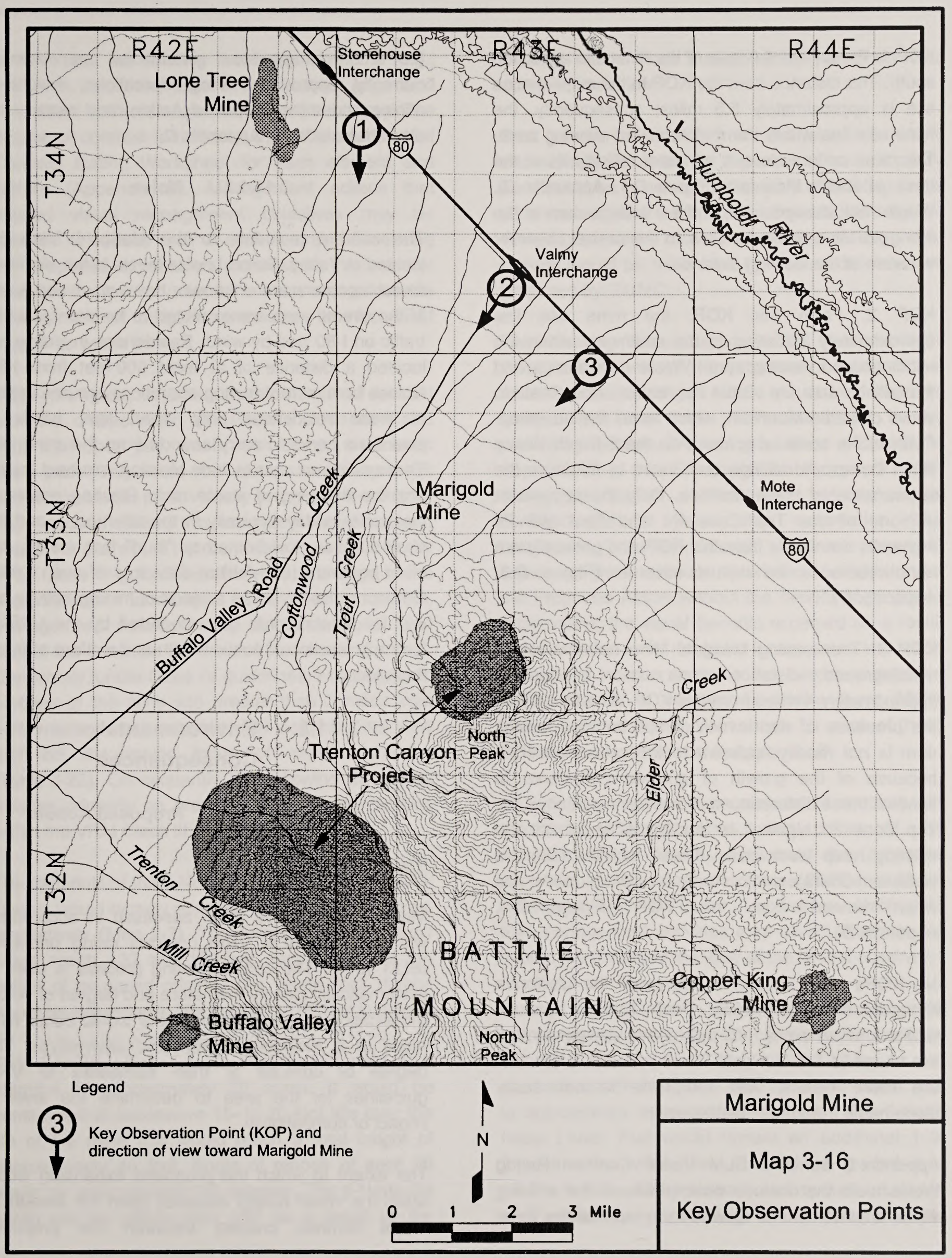
To assess the degree of visual contrast that would result from implementation of the proposed project, KOPs were selected from which changes to the characteristic landscape could be compared. KOPs are typically chosen along commonly traveled routes or at other likely observation points (BLM 1986).

The study area is visible over an approximate 10-mile corridor along I-80. Maximum visibility of the study area and the existing mine occurs at the Valmy Interchange and at the Valmy rest stop, located approximately 2.5 miles northeast of the existing mine. The study area also is visible from the Buffalo Valley Road and a portion of the California Emigrant National Historic Trail.

The California Emigrant National Historic Trail is described in Section 3.14, Cultural Resources, Ethnography, and Paleontology. The Trail generally parallels I-80 about 1 mile farther north, from the Edna Mountain foothills to Battle Mountain. There is considerable interest by groups such as the Oregon-California Trails Association, Trails West, Inc., and the Nevada Commission on Tourism concerning development affecting viewsheds along the California Emigrant National Historic Trail (Dodd 1997). Most of the California Emigrant National Historic Trail has been marked, mapped, and described in detail. The Trail section from the Edna Mountain foothills to Battle Mountain has four trail markers and published diary accounts for each location (Helfrich and Hunt 1984).

For the purposes of this analysis, the following KOPs have been identified for this EIS. The location of the viewpoints and the direction of the view toward the study area are listed below and shown in Map 3-16.

1. Mile marker 213 on I-80 located approximately 1 mile southeast of the Stonehouse Interchange;
2. Mile marker 216 on I-80, the Valmy rest stop; and
3. Mile marker 218.4 on I-80.


R42E
R43E
R44E
T34N
T33N
T32N
Lone Tree Mine
Stonehouse Interchange
1
80
Humboldt River
Valmy Interchange
2
3
Marigold Mine
Mote Interchange
80
Buffalo Valley Road
Cottonwood Creek
Trout Creek
Creek
Trenton Canyon Project
North Peak
Elder Creek
Trenton Creek
Mill Creek
BATTLE MOUNTAIN
North Peak
Copper King Mine
Buffalo Valley Mine
Legend
3
Key Observation Point (KOP) and direction of view toward Marigold Mine
N
0 1 2 3 Mile
Marigold Mine
Map 3-16
Key Observation Points

KOP 1. From KOP 1, views of the mine site are to the south. The distance from the KOP to the current mine site is approximately 5.5 miles; consequently, the mine site lies within the middleground viewing zone. The mine occurs along a series of rolling hills at the base of Battle Mountain (Figure ***D***-1, Appendix ***D***). Waste rock ***dumps***, pits, and the tailings dam of the Marigold Mine are not visible to the casual observer because of the viewing distance.

KOP 2. From this KOP, the mine site lies approximately 3.5 miles to the southwest within the middleground viewing zone. Waste rock dumps and the tailings dam are visible but remain subordinate to views of Battle Mountain, which forms the backdrop. Further, the cover of grasses on the 8-South Waste Rock Dump and tailings dam serve to minimize the appearance of these facilities. Only the uppermost portions of the Top Zone Pit and East Hill Pit highwalls are visible from this KOP and generally are unnoticeable to the casual observer (Figure ***D***-3, Appendix ***D***).

KOP 3. The existing Marigold Mine appears in the middleground distance zone and is located approximately 4 miles from this KOP. As with KOP 2, the presence of waste rock dumps and the tailings dam is not readily apparent to the casual observer because of the growth of grasses that serve to conceal these disturbances. However, a portion of the Top Zone Pit highwall is readily visible as are the existing heap leach pads. These facilities create a weak to moderate contrast with the natural landscape when viewed from this KOP (Figure ***D***-5, Appendix ***D***).

No KOPs were chosen to represent the California Emigrant National Historic Trail. This is because KOPs chosen along I-80 represent viewpoints that are closer to the Marigold Mine; views from the trail are more distant, and the mine is not easily discernable from these distances.

Appendix ***D*** contains BLM Visual Contrast Rating Worksheets that include descriptions of the existing visual environment as viewed from each of the three KOPs. Photographic simulations representing currently approved mining operations, height of mining under the Proposed Action, and reclamation also are included in Appendix ***D***.

#### 3.11.1.2 Noise

The nearest residents to the Marigold Mine are located at Valmy. Current noise levels in the vicinity of these receptors are unknown; however, noise levels in the overall area are expected to be dominated by traffic on I-80 and by wind. Residences in Valmy are located a distance of at least 500 feet from I-80. Noises from current mining operations are perceptible at these residences only when light winds or inversions serve to carry sounds from the mine site. These noise sources include blasting, ore haul trucks, and the dumping of waste rock. Blasting occurs at least once a day (typically in the afternoon), and the short-duration, low-frequency "thud" that results can often be heard (and felt) at distances of over 1 mile. Outdoor noise levels as a result of mining activity are well below standards recommended by the USEPA for the protection of public health and welfare at these receptors.

### 3.11.2 Environmental Consequences

#### 3.11.2.1 Proposed Action

**Visual Resources**

Visual impacts have been assessed in accordance with standard BLM VRM contrast rating principles (BLM 1986). The contrast rating process is used to systematically identify the nature and degree of visible modification to the landscape that would occur as a result of a Proposed Action and alternatives. The degree of contrast is then compared to VRM guidelines for the area to determine the level of impact or compatibility.

The extent to which the proposed expansion would affect the visual quality depends upon the amount of visual contrast created between the proposed

facilities and the existing landscape elements (e.g., form, line, color, and texture) and features (e.g., land and water surface, vegetation, and structures). The degree of contrast is rated on a standardized Visual Contrast Rating Worksheet for each element and feature (Appendix ***D***). Management actions that exceed visual management objectives may be required to reduce their overall contrast. Assessing the proposed expansion's contrast in this manner indicates the level of potential impacts and guides the development of mitigation measures so the VRM objectives would be met.

Major mining elements that have potential to contrast with the characteristic landscape include new and expanded open pits, waste rock dumps, and heap leach pads. The waste rock dumps and heap leach pad would be the most visually prominent features of the Proposed Action; the expanded Red Rock and Top Zone pits would not be visible from I-80. Under VRM Class III guidelines, the level of change to the characteristic landscape can be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Conversely, under Class IV guidelines, which apply to portions of the mine site greater than 3 miles from I-80, management activities may dominate the view and be the major focus of viewer attention (Table 3-22). Consequently, the following discussion focuses primarily on proposed new mining facilities within the VRM Class III designation.

The footprints of the 5-North and 8-North Waste Rock Dumps would occupy approximately 55 and 85 acres, respectively (Map 2-2). The height of these dumps would reach 120 and 150 feet, respectively, at the height of proposed mining. The waste rock dumps would be expanded in lifts from 50 to 60 feet in height.

The 5-North Heap Leach Pad would require a footprint of approximately 30 acres. It would be constructed in successive 15- to 20-foot lifts over the life of the mine and would reach a total height of approximately 40 feet. Angle of repose of each lift would be approximately 38 degrees. The 5-North Pit would not be visible from I-80 as a result of the 5-North Waste Rock Dump, which would serve to screen it from view.

Dust plumes originating from the mine area could occasionally be visible for distances of several miles. Dust could be generated as a result of blasting in the pit area, vehicular traffic on haul roads, and by the dumping of waste rock. The creation of large dust plumes would be minimized by wetting dirt roads as proposed by GMMC.

The following discussion describes in more detail those components of the proposed expansion that would result in changes to the visual landscape as viewed from the three KOPs described in the preceding section. Visual simulations included in Appendix ***D*** of this EIS depict the Proposed Action during the period of maximum potential visual contrast and 10 years after reclamation. The maximum potential visual contrast scenario represents the maximum disturbance possible under the Proposed Action without the benefit of proposed reclamation; the visual benefits expected as a result of reclamation have not been incorporated into these simulations in order to depict the maximum potential visual contrast at the end of mining (year ***2007***). Visual Contrast Rating Worksheets for each of these KOPs also are presented in Appendix ***D***.

Overall, the proposed expansion would contrast with the existing forms, lines, and colors of the characteristic landscape. However, the proposed expansion at the end of mining (***2007***) would be consistent with VRM Class III objectives, which state that management activities may attract attention but should not dominate the view of the casual observer.

During mining closure activities, the waste rock dumps would be graded to eliminate the benches between lifts, reduce the side slopes to an approximate 3H:1V grade, and round-off waste rock to approximate more natural contours. The 5-North Heap Leach Pad would remain an additional 1 to 2 years, after which time it would be graded in a similar fashion. Mine access roads would be ripped and reseeded, and buildings and ancillary facilities

would be removed and their foundations ripped and reseeded.

Reclamation activities proposed by GMMC are described in Section 2.2.19, Reclamation, and include slope grading and stabilization, the application of growth media, and the seeding of disturbed areas. Figures ***D***-2, ***D***-4, and ***D***-6 in Appendix ***D*** depict anticipated conditions 10 years after reclamation begins under the proposed expansion. The grading of waste rock and heap leach slopes from angle of repose to approximately 3H:1V would create undulating slopes that would more closely approximate the appearance of natural slopes in the area. These efforts would reduce any moderate contrasts in land forms and lines associated with the proposed expansion to weak contrasts, that would not tend to attract the attention of the casual observer.

Revegetation practices at the Marigold Mine to date in such areas as the 8-South Waste Rock Dump have been extremely successful and have resulted in densities of grasses, forbs, and shrubs similar to those of adjacent undisturbed areas. Assuming the revegetation program for the proposed expansion meets with similar success, visual contrasts associated with all current and proposed mine disturbance would be greatly reduced over time. Within a few years, grasses, forbs, and shrubs on the waste rock dumps and leach pads would allow these areas to blend with the color and texture of the existing natural landscape, thereby eliminating any remaining contrasts associated with the proposed expansion. Therefore, visual contrasts associated with the proposed expansion would be reduced over time and would repeat the basic elements of form, line, color and texture found in the characteristic landscape. The reclaimed mine area would not attract the attention of the casual observer when viewed from any of the three KOPs used in this analysis. Consequently, the proposed expansion would conform to VRM Class III guidelines after the reclamation period.

**Noise**

Although the proposed expansion would perpetuate the types of noises that currently are generated by mining activity at the mine, it also would extend the overall life of the mine, during which time sensitive receptors would continue to experience mine-related noises throughout the day and night. Specifically, the proposed project would extend the life of current mining operations an additional 5 years, through the year ***2007***. Sound levels from mining activities during this period are expected to be similar to those that occur now; blasting would continue within the open pit during daylight hours and construction equipment (i.e., drills, bulldozers, loaders, and haul trucks) would operate 24 hours per day. Because mine expansion is not expected to significantly intensify sound levels, as compared to current mining operations, noise impacts to residents in Valmy would not be significant.

Blasting during the life of the proposed expansion would occur during daylight hours only, and noise experienced at any one site would be of very short duration (approximately 0.5 second). Blasting would occur below ground level and noise from blasting would largely be attenuated by the surrounding terrain. No changes in the size of charges used or method of detonation from the existing (on-going) blasting program are anticipated. Under the proposed expansion, blasting noise would continue an additional 5 years and could startle residents of Valmy even though such noise currently occurs, and would continue to occur, at regular intervals on a daily basis. The proposed expansion would represent only an increase in the duration over which currently ongoing noises would occur.

The proposed expansion is not expected to result in a long-term increase in traffic over current mining-related levels. Consequently, the proposed project would not contribute to an increase in noise along local roadways during the extended life of mining operations.

Noise levels associated with mine closure activities would not be expected to differ significantly from

those described for mining operations, since the primary noise sources would be from the use of bulldozers and other heavy equipment; however, these noise-generating activities would only occur during daylight hours. Blasting would cease with mine closure.

Noise levels associated with mine reclamation activities would not be expected to differ significantly from those described for mining operations. As with mine closure, the primary noise sources from reclamation activities would be from the use of bulldozers and other heavy equipment. These noises would diminish over the reclamation period as site activities and related traffic diminish. After the reclamation period, noise in the vicinity of the mine site would return to pre-mining levels.

#### 3.11.2.2 8-South Partial Pit Backfill Alternative

Implementation of the 8-South Partial Pit Backfill Alternative would result in visual contrasts that would be similar to those described for the Proposed Action. Construction of the 8-North Waste Rock Dump would not be necessary; all other mining facilities would appear as shown for the Proposed Action in Figures ***D***-1, ***D***-2, ***D***-3, ***D***-4, ***D***-5, and ***D***-6 in Appendix ***D***. Therefore, some mine elements would result in moderate contrasts at the height of mining (e.g., 5-North Waste Rock Dump and Heap Leach Pad) and VRM objectives would be maintained, primarily as a result of the long viewing distance from each KOP.

Reclamation practices associated with this alternative would be identical to those described for the Proposed Action (Section 2.2.19, Reclamation). As with the Proposed Action, reclamation would all but eliminate any remaining visual contrasts associated with the mine expansion, and VRM objectives would be maintained.

Noise impacts associated with mine operations, closure, and reclamation under this alternative are not expected to differ from those described for the Proposed Action.

#### 3.11.2.3 No Action Alternative

Under the No Action Alternative, currently permitted mining operations would continue through 2001, after which time the Marigold Mine would cease operations. The additional disturbance associated with the Proposed Action (expansion of the open pits, waste rock dumps, and the construction of a new heap leach pad and other mining-related facilities) would not occur within the project area. The visual environment at the end of current mining operations from each of the three KOPs would be similar to that depicted in Figures ***D***-1, ***D***-3, and ***D***-5 in Appendix ***D***. GMMC would be required to reclaim surface disturbances associated with its permitted operations.

Noise from current mining operations would continue under the No Action Alternative until 2001. Noise levels in the mine area would return to pre-mining levels after closure and reclamation activities were complete.

### 3.11.3 Cumulative Impacts

Cumulative effects to esthetic resources were considered for all past, present, and reasonably foreseeable future developments listed in Section 2.6, Interrelated Projects, that have the potential to be visible from either of the three KOPs identified in Section 3.11. These developments include the existing Lone Tree Mine and the recently approved Trenton Canyon Mine (Map 3-16).

The Lone Tree Mine is located approximately 5 miles north of the Marigold Mine in the vicinity of Lone Tree Hill. Several mine-related facilities (e.g., waste rock dumps, heap leach pads) are located within one mile of I-80 and tend to attract the attention of motorists. A waste rock dump associated with the Lone Tree Mine

lies within the field-of-view of KOP 1 and dominates the view of motorists on I-80 near this location. This waste rock dump serves to completely block views of the Marigold Mine at locations further west on I-80, such as the Stonehouse interchange. The location of KOP 1 was chosen in order to represent the point at which facilities associated with the Lone Tree Mine no longer dominated views south to the Marigold Mine. Consequently the Lone Tree Mine does not appear in the photographs of existing conditions taken at KOP 1 (Figure ***D***-1, Appendix ***D***).

The Trenton Canyon Mine would be located along the northern and northwestern flanks of Battle Mountain, several miles south of the Marigold Mine (Map 3-16). The cumulative visual impact of the Trenton Canyon Mine, as viewed from KOPs 1, 2, and 3, is depicted for height of mining at the Marigold Mine in Figures ***D***-1, ***D***-3, and ***D***-5 in Appendix ***D***. As demonstrated by these simulations, disturbance associated with the Trenton Canyon Mine would be visible and could serve to attract the attention of motorists on I-80. The relative level of visual contrast created by the Trenton Canyon Mine would be stronger than that created by the expanded Marigold Mine; however, the Trenton Canyon Mine would be located entirely within a VRM Class IV area where the allowable levels of change to the characteristic landscape can be high (Table 3-21).

### 3.11.4 Potential Mitigation and Monitoring

No mitigation or monitoring needs were identified.

### 3.11.5 Residual Adverse Impacts

No residual adverse impacts were identified.

# 3.12 Social and Economic Values

## 3.12.1 Affected Environment

This section describes the social and economic conditions in the project area. The study area is determined by the areas where socioeconomic impacts potentially occur. The Marigold Mine is located in southern Humboldt County. Approximately 50 percent of current mine employees reside in or near Battle Mountain, in Lander County. Forty-eight percent of employees reside in or near Winnemucca (Humboldt County), and 2 percent reside in Elko (Elko County) (JBR 1999).

As determined by the employee residence pattern and the mine location, the analysis area for social and economic issues encompasses primarily Humboldt and Lander counties and the communities of Winnemucca and Battle Mountain. Issues discussed in this section include population; economy, employment, and income; housing and community services; and government and public finance. The following description of the affected environment was developed through review of existing literature and statistical data, and through direct contact with area representatives, and local, state, and Federal agencies.

### 3.12.1.1 Population And Demography

Humboldt and Lander counties are sparsely populated, rural counties. This area of Nevada has demonstrated a strong growth trend over the past two decades, largely in response to the growth in the mining industry. Table 3-23 shows population statistics for the study area from 1990 to 1998. Humboldt County population increased 22.3 percent during this period, or an average of 2.8 percent per year, to a 1998 population of 15,920 (Bureau of Business and Economic Research 1997; JBR 1999). Lander County population increased 11 percent during the period, or an average of 1.4 percent per year, to a 1998 population of 7,040. According to 1990 census data, 9.6 percent of Lander County's population was made up of minorities (non-whites). Humboldt County had 17.4 percent minorities, a relatively high number for Nevada due to the large number of Hispanics employed in agricultural labor. Age distribution in Humboldt County is similar to the pattern in the rest of the state and nation. The Lander County population is generally younger than the rest of the state and nation (Tri-County Development Authority 1996a, 1997).

Approximately 48 percent of Humboldt County's population resides in the town of Winnemucca, which had a 1998 population of 7,482 (Bureau of Business and Economic Research 1997). Winnemucca's population increased 21.1 percent from 1990 to 1998, or an average of 2.6 percent per year. The small community of Golconda, located 16 miles from Winnemucca, has an estimated population of 400 to 500. Approximately 64 percent of Lander County's population resides in the town of Battle Mountain, which had a 1998 population of 5,360. Battle Mountain's population increased 1.6 percent from 1990 to 1998, or an average of 0.2 percent per year.

Continued growth is anticipated for Humboldt and Lander counties through 2008, although growth rates are not expected to be as high as in the 1990 to 1998 period. Humboldt County's population is anticipated to increase 34.8 percent in the 10-year period from 1998 to 2008, or approximately 3.5 percent per year, to reach a 2008 population of 21,460. Lander County's population is anticipated to increase 16.5 percent in the 10-year period, or approximately 1.7 percent per year, to reach a 2008 population of 8,200 (Nevada Department of Administration 1999). However, these population forecasts may change as a result of fluctuations in gold prices and possible changes in employment at area mines.

Table 3-23
Study Area Population

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | Percent Change 1990-98 | Average Annual Growth Rate 1990-98 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Humboldt County | 13,020 | 13,500 | 14,000 | 14,510 | 15,640 | 16,270 | 16,460 | 16,900 | 15,920 | 22.3 | 2.8 |
| Winnemucca Division | 6,180 | 6,560 | 6,640 | 6,910 | 7,170 | 7,380 | 7,890 | 8,140 | 7,482 | 21.1 | 2.6 |
| Lander County | 6,340 | 6,370 | 6,380 | 6,430 | 6,410 | 6,440 | 6,710 | 7,030 | 7,040 | 11.0 | 1.4 |
| Battle Mountain Division | 5,276 | 5,300 | 5,308 | 5,350 | 5,341 | 5,341 | 4,932 | 5,170 | 5,360 | 1.6 | 0.2 |

Source: Bureau of Business and Economic Research 1997; U.S. Department of Commerce 1991.

### 3.12.1.2 Economy, Employment, and Income

**Overview of the Economy**

The economies of Humboldt and Lander counties have historically depended on agriculture and mining. Winnemucca, in Humboldt County, developed around a trading post located at an important fording site on the Humboldt River for westward-bound pioneers on the California Emigrant Trail. In 1869, the Central Pacific Railroad further bolstered the area's economic growth. Winnemucca continued to be a major trade center for the area, and extended its role as a rest stop for travelers with the construction of I-80.

Mining, with its boom and bust history, has played a major role in the economy of the area since the first rushes for gold and silver occurred. In the early 1900s, the silver rush resulted in a significant influx of prospectors and related population growth. The most recent boom, associated with the development of Carlin-type gold deposits, peaked in the late 1980s, but continues today. The economies of Humboldt and Lander counties continue to be based primarily on the mining industry, and to a lesser extent on agriculture and tourism. A study conducted by the Economic Development Administration's University Center for Economic Development at the University of Nevada, Reno reported that over 56 percent of total economic activity in Humboldt County is created by the gold mining sector. Thus, while direct employment by the mining industry accounted for less than one-third of the labor force in Humboldt County, the industry provided over one-half of the economic activity and three-quarters of the income in the county (Tingley et al. 1993; Tri-County Development Authority 1996a).

This economic dependence on the mining industry makes the regional economy very vulnerable to external conditions, such as fluctuations in world metals demand and prices. This potential risk has been noted by local development authorities. Overall Economic Development Plans have been developed for both Humboldt and Lander counties to provide direction and support in developing other industries and economic activities in order to diversify the economy. Target industries for development include gaming/tourism, recreation, agriculture, geothermal resources, and industrial development (Tri-County Development Authority 1996a, 1997).

Agriculture continues to contribute to the base of economic activity in both Humboldt and Lander counties. In 1997, there were 76 farms and ranches in Lander County, encompassing 486,017 acres, and 218 farms and ranches in Humboldt County, encompassing 733,418 acres. Humboldt County is one of the leading agricultural counties in Nevada. The livestock industry plays an important role in both counties, with 21,000 head of cattle in Lander County and 63,000 in Humboldt County in 1998 (Nevada Department of Administration 1999).

Tourism has become increasingly important in the economy with the growth in the gaming industry, as is reflected in the recent increases in the services and trade sectors. These activities center around the urban areas of Winnemucca and Battle Mountain. The services and trade sectors, in general, require much lower skill levels for operation and, therefore, average wages are much lower in these sectors than in the mining sector. These sectors do contribute to regional economic diversity.

**Employment and Income**

Lander County and Humboldt County labor force, employment, and wage statistics are shown in Tables 3-24 and 3-25. Between 1993 and 1998, the Lander County labor force remained fairly constant, measuring 2,930 in 1998 (Research and Analysis Bureau 1991-1995; Employment Security Division 1999). The unemployment rate fluctuated, averaging around 9.5 percent. The Humboldt County labor force increased 11.3 percent in the 5-year

**Table 3-24**
**Lander County Labor Force Summary**

| | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | Percent of Employment 1998 | Percent of Payroll 1997 | Average Annual Pay 1997 |
|---|---|---|---|---|---|---|---|---|---|
| Total Labor Force[1] | 2,980 | 2,890 | 2,900 | 3,060 | 3,060 | 2,930 | --- | --- | --- |
| Unemployment | 340 | 300 | 260 | 260 | 210 | 300 | --- | --- | --- |
| Unemployment Rate | 11.4% | 10.4% | 9.1% | 8.6% | 6.9% | 10.3% | --- | --- | --- |
| Employment by Sector:[2] | | | | | | | | | |
| Mining | 1,030 | 980 | 1,080 | 1,210 | 1,290 | 1,110 | 44.6 | 67.1 | 50,508 |
| Construction | 50 | 120 | 90 | 100 | 30 | 30 | 1.2 | 0.7 | 20,268 |
| Manufacturing | 40 | 40 | 40 | 40 | 40 | 40 | 1.6 | 2.2 | 49,036 |
| Transportation, Communication, & Utilities | 120 | 120 | 90 | 90 | 90 | 80 | 3.2 | 2.6 | 31,181 |
| Wholesale and Retail Trade | 320 | 410 | 430 | 470 | 460 | 400 | 16.1 | 6.7 | 14,299 |
| Finance, Insurance, & Real Estate | 30 | 30 | 30 | 30 | 30 | 40 | 1.6 | 0.6 | 16,221 |
| Service Industries | 290 | 230 | 220 | 240 | 230 | 190 | 7.6 | 3.9 | 15,258 |
| Government | 500 | 520 | 540 | 560 | 560 | 690 | 27.7 | 16.3 | 30,314 |
| TOTAL, All Industries | 2,380 | 2,440 | 2,510 | 2,740 | 2,740 | 2,490 | 100.0 | 100.0 | 35,883 |

[1]Reflects employment by place of residence.
[2]Reflects non-agricultural employment by place of employment.

Note: Numbers may not add to total due to rounding.

Source: Research and Analysis Bureau 1991-1995; Employment Security Division 1999.

**Table 3-25**
**Humboldt County Labor Force Summary**

| | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | Percent of Employment 1998 | Percent of Payroll 1997 | Average Annual Pay 1997 |
|---|---|---|---|---|---|---|---|---|---|
| Total Labor Force[1] | 7,880 | 7,870 | 8,030 | 8,390 | 8,770 | 8,570 | --- | --- | --- |
| Unemployment | 480 | 460 | 350 | 340 | 350 | 560 | --- | --- | --- |
| Unemployment Rate | 6.1% | 5.8% | 4.3% | 4.1% | 4.0% | 6.5% | --- | --- | --- |
| Employment by Sector:[2] | | | | | | | | | |
| Mining | 2,090 | 2,075 | 2,305 | 2,490 | 2,450 | 2,010 | 25.9 | 45.4 | 48,518 |
| Construction | 370 | 369 | 414 | 570 | 550 | 390 | 5.0 | 6.4 | 30,493 |
| Manufacturing | 100 | 102 | 134 | 190 | 200 | 180 | 2.3 | 2.2 | 29,942 |
| Transportation, Communication, & Utilities | 300 | 305 | 335 | 370 | 400 | 410 | 5.3 | 6.1 | 40,983 |
| Wholesale and Retail Trade | 1,170 | 1,271 | 1,394 | 1,460 | 1,580 | 1,730 | 22.3 | 11.4 | 19,024 |
| Finance, Insurance, & Real Estate | 100 | 107 | 102 | 110 | 110 | 110 | 1.4 | 1.0 | 23,947 |
| Service Industries | 1,520 | 1,860 | 1,955 | 1,630 | 1,710 | 1,530 | 19.7 | 13.1 | 16,782 |
| Government | 1,230 | 1,163 | 1,130 | 1,300 | 1,370 | 1,410 | 18.2 | 14.3 | 30,378 |
| TOTAL, All Industries | 6,890 | 7,253 | 7,770 | 8,100 | 8,360 | 7,760 | 100.0 | 100.0 | 30,620 |

[1]Reflects employment by place of residence.
[2]Reflects non-agricultural employment by place of employment.

Note: Numbers may not add to total due to rounding.

Source: Research and Analysis Bureau 1991-1995; Employment Security Division 1999.

period from 1993 to 1997, and then declined 2.3 percent to a 1998 figure of 8,570. The unemployment rate fluctuated, averaging around 5.1 percent. The unemployment rates in both Lander and Humboldt Counties have been fairly high recently, measuring 10.3 percent and 6.5 percent, respectively, in 1998.

Non-agricultural employment by sector information is displayed in Tables 3-24 and 3-25. The most important non-agricultural employment sectors in Lander County are mining (44.6 percent of 1998 employment), government (27.7 percent), trade (16.0 percent), and services (7.6 percent) (Employment Security Division 1999). In the 6 years from 1993 to 1998, growth occurred primarily in the government sector. Mining employment increased slightly. In 1997, there were four major mining operations in Lander County, and mining provided approximately 45 percent of total county non-agricultural employment (Tri-County Development Authority 1999).

Humboldt County's distribution of non-agricultural employment by sector is similar to Lander County's, with slightly smaller portions attributable to mining (25.9 percent), and more to government (18.2 percent), trade (22.3 percent), and services (19.7 percent), reflecting the commercial activity in Winnemucca. Mining employment in Humboldt County provides approximately 29 percent of total county non-agricultural employment (Tri-County Development Authority 1999). Employment in most sectors increased from 1993 to 1997, and declined from 1997 to 1998 (Research and Analysis Bureau 1991-1995; Employment Security Division 1999). Current employment at the Marigold Mine totals ***100*** employees.

Average wages in the mining sector are the highest of any employment sector (Tables 3-24 and 3-25). The 1997 average annual pay in Lander County over all industries was $35,883, while the average pay in the mining sector was $50,508. Average annual pay in the manufacturing sector was $49,036, making it the second highest paid non-agricultural employment sector. Mining provided 67.1 percent of the total direct payroll earned in Lander County in 1997. Manufacturing provided only 2.2 percent (government was second highest, with 16.3 percent). Figures for Humboldt County were similar. Mining provided 45.4 percent of the total direct payroll earned in 1997, government 14.3 percent, and services 13.1 percent. Average annual pay over all industries is slightly lower in Humboldt County (at $30,620) than in Lander County (Employment Security Division 1999).

**Indirect Contributions of Mining**

As stated before, the total economic contribution provided by mining is greater than simply direct employment or wages. Mining industry employment supports secondary employment in other industries, particularly services, through the spending of workers' wages in the local economy, and also through the purchase of goods and services by mining firms. Secondary employment is calculated for the mining industry using a multiplier of 1.24 for rural settings in Nevada (Dobra 1988, 1989). For every direct job in the mining industry, 0.74 indirect jobs are created in the local economy, and 0.5 jobs are created in the large urban economies of the state, which serve as supply centers. This multiplier was determined by John Dobra, an economist at the University of Nevada, Reno, in 1988, and it has been used in numerous socioeconomic analyses for mines in Nevada. Using this multiplier, secondary employment in local communities supported by Marigold Mine direct employment is estimated to be 61. Most of these jobs occur in the services and trade sectors.

Mining, as an export industry, is an important income-generator for the state and has the largest earnings multipliers of any industry. The majority of the revenue from the sale of the product is spent within the state on wages, taxes, purchases of goods and services, and other production expenses. The total earnings generated through mining activity, as income cycles through the economy, can be estimated using a multiplier of 1.57 (Dobra 1989). This number applies to the amount spent directly on payroll (i.e., for every payroll dollar in the mining

industry, an additional $1.57 in earnings is generated for other Nevadans in the form of wages and salaries, rents, interest, and business incomes). Using this multiplier, the $4.5 million in payroll (1998) at Marigold Mine is estimated to generate approximately $7.1 million in additional earnings throughout the state.

### 3.12.1.3 Housing and Community Services

Housing and community services are analyzed to the extent that they would be impacted by population changes generated by the proposed project. Based on the current employee residence distribution, the primary communities affected are Winnemucca and Battle Mountain. Residence of employees in other communities is negligible. This section describes the housing and basic public services available in these communities.

**Housing**

The 1990 U.S. Census reported that there were 5,044 total housing units in Humboldt County, with 506 of these units vacant (U.S. Department of Commerce 1991). The housing stock consisted of 2,421 single-family units, 502 attached and apartment units, and 2,121 mobile homes. Of the Humboldt County housing stock, 2,442 housing units were located in Winnemucca (1,413 single-family units, 442 attached and apartment units, and 587 mobile homes). The 1996 Overall Economic Development Plan Update for Humboldt County reports that between 1991 and 1995, 180 housing units were constructed in Winnemucca (Tri-County Development Authority 1996a). During the same period, 824 housing units were built in unincorporated Humboldt County, of which 42 were single-family units and 782 were mobile homes.

Demand for housing in Humboldt County has been very high for the past 10 years. In 1995, prices for homes in the Winnemucca area ranged from $37,500 to $199,000, with an average price of $110,000. Manufactured housing prices ranged from $25,000 to $132,000. Residential lots in the city ranged from $25,000 to $32,000 depending upon size and location. According to area realtors, there are 100 to 150 homes for sale in an average month, and listings are on the market from 60 to 120 days, depending on quality and price (JBR 1999).

The 1990 U.S. Census reported that there were 2,586 total housing units in Lander County, with 374 units vacant (U.S. Department of Commerce 1991). The housing stock consisted of 867 single-family units, 118 attached and apartment units, and 1,602 mobile homes. Housing in Lander County is primarily owner-occupied, and the majority of rental properties are mobile homes. In 1995, prices for homes in the Battle Mountain area averaged $55,000 to $65,000 (Tri-County Development Authority 1996b). On average, about 40 properties are for sale in a given week, and properties are on the market an average of 4 to 6 months (JBR 1999).

According to the 1990 Census, there were approximately 1,484 rental units in Humboldt County, with 871 rental units in Winnemucca (U.S. Department of Commerce 1991). In Lander County, there were 629 rental units, with 449 rental units in Battle Mountain. According to area realtors and property management personnel in 1996, the rental markets in the region are very limited (BLM 1996a). However, the housing market has loosened as the mining industry has reduced employment and population has slowed or even stabilized (JBR 1999). According to local realtors, the average monthly rent in the Winnemucca region for homes, apartments, or mobile homes in 1995 were $400 to $450 for 1-bedroom units, $450 to $500 for 2-bedroom units, and $500 and up for 3-bedroom units. According to a 1996 community profile of Lander County, the average rent for a 2-bedroom multi-family unit in Battle Mountain was $400 to $500 (Tri-County Development Authority 1996b).

Temporary housing in Humboldt County is concentrated in Winnemucca. There are an estimated 1,600 hotel/motel rooms in Winnemucca (Tri-County Development Authority 1996b). At least a third of

these rooms are available for rental by the week (JBR 1995). Temporary housing in Lander County is concentrated in Battle Mountain. There are 8 hotels/motels in Battle Mountain, with approximately 386 rooms (Tri-County Development Authority 1997). Parking and hook-up services for recreational vehicles also are available in the project area. The busiest tourist season begins in June and ends in September. Weekend vacancy rates for temporary housing accommodations in Winnemucca during this period are frequently near zero (BLM 1996a).

**Water Supply**

It is estimated that 50 percent of Humboldt County households are served by either a public or private water company. The Winnemucca area is served by the city's water system. Two other water districts exist in the county. The remainder of the county utilizes water from individually drilled wells, developed springs, or localized non-community systems. The Winnemucca water system serves approximately 3,000 customers. The average demand is 3.0 million gallons per day (mgd), with a peak demand of 6.5 mgd during the summer months. Water is supplied by a system of four deep wells and one developed spring. Total storage capacity is 7.85 million gallons in several storage tanks. Current annual use on the system is approximately 2,500 acre-feet per year. A new 2,400-gallon per minute well went online in 1999 (JBR 1999). A recent study concluded that an ultimate build-out (full development) of the Winnemucca service territory would require approximately 11,205 acre-feet per year. It is estimated that the system is capable or nearly capable of providing this amount of water (Tri-County Development Authority 1996a).

Battle Mountain Water and Sewer provides water to approximately 4,000 people in the Battle Mountain area. The remainder of Lander County utilizes individually drilled wells or developed springs. The annual average demand in the Battle Mountain area is 1.0 mgd, and approximately 2.0 mgd in summer. Water is supplied by three wells that are currently operating at about half capacity. A fourth well is scheduled to be operational by 2000 (JBR 1999).

**Wastewater Treatment**

Approximately 66 percent of all Humboldt County households are connected to a wastewater treatment facility. Winnemucca has a wastewater treatment facility; two other small treatment facilities exist in the county. The remainder of the county utilizes individual septic systems. The Winnemucca facility has a 2.5 mgd capacity, and serves approximately 2,800 customers. The average flow in the system is 1.2 mgd. The collection system presently consists of three large and two small lift stations. Excess capacity exists in the system to serve additional customers; however, any development outside of the present service area would require construction of additional lines (Tri-County Development Authority 1996a; JBR 1999).

Battle Mountain Water and Sewer handles 430,000 gallons per day in sewage. All rural areas in Lander County utilize individual septic systems. The system has the capacity to handle approximately 1.2 mgd; service is presently operating at approximately 36 percent of capacity. Expansion plans under consideration include a SBR activator sludge plant and an additional pond, to handle increased population (Tri-County Development Authority 1996a, 1997; JBR 1999).

**Solid Waste Disposal**

In 1995, there were 10 rural landfills in Humboldt County. Most of these were scheduled to be closed by the end of 1997 due to recent changes in Federal and state regulations. A private operator currently directs the Winnemucca Area Solid Waste Management District, under contract with the City of Winnemucca and Humboldt County. The regional landfill is located 5 miles north of Winnemucca. The landfill is being permitted as a non-hazardous municipal solid waste landfill. The current site encompasses 240 acres and has a life expectancy of 40 years. Collection service in the Winnemucca area

is provided by two private operators (Tri-County Development Authority 1996a; JBR 1999).

Solid waste disposal in the Battle Mountain area is provided at a Class III disposal site which has the capacity to process up to 20 tons of waste per day. Actual figures of present utilization at the facility are unavailable because process scales are not fully operational. At current disposal volumes, the facility is expected to be able to handle the area's waste disposal needs for the next 13 years (JBR 1999).

**Schools**

Winnemucca has 3 elementary schools, 1 middle school, 1 junior high school, and 1 high school, with a total capacity in 1995 of 3,965 students. Total enrollment for the 1998-1999 school year was 3,879. Enrollment increased an average of 5.2 percent from 1991 to 1998. However, in the past year, enrollment increased only 0.1 percent. The ratio of students to teachers has been 16 to 1 since 1994. Several of the schools are nearing capacity, and modular classrooms are utilized to accommodate additional students, where necessary. The high school, in particular, is very close to capacity. The Humboldt County School District recently completed construction of a new physical education facility at the high school, as part of a 4-year expansion, which will eventually include administrative offices, a media center, cafeteria, and 10 classrooms. This expansion will increase the capacity of the high school from 1,000 to 1,200 students (BLM 1996a; JBR Environmental Consultants, Inc. 1999).

The Lander County School District has 3 elementary, 1 junior high, and 1 high school, all located in Battle Mountain, with an additional elementary school and high school located in Austin. The total district enrollment in Battle Mountain schools in the fall of 1998 was 1,625 students. The ratio of students to teachers in 1998 was 17 to 1. Enrollment has fluctuated since 1986, with a general increase from 1986 to 1997, and decreases in the last 2 years. With the addition of a new elementary school in 1998, the district has increased capacity to accommodate additional students at the elementary school level (JBR 1999).

**Law Enforcement and Fire Protection**

Law enforcement in Humboldt County is provided by the Humboldt County Sheriff's Department, the Winnemucca Police Department, and the Nevada Highway Patrol. The Humboldt County Sheriff's Department provides police protection throughout Humboldt County. The sheriff's staff includes 20 deputies, 4 reservists, and 11 detention officers. In addition to law enforcement, the sheriff's department oversees the Humboldt County Detention Center, which has a current capacity of 61 inmates. The Winnemucca Police Department serves the City of Winnemucca, and additional areas, in cooperation with the Sheriff's Department, as necessary. The Winnemucca Police Department has a staff of 15 officers and 2 reservists. Currently the Department is in need of at least one additional officer to provide adequate urban protection. Law enforcement in Lander County is provided by the Lander County Sheriff's Department, based in Battle Mountain, with a staff of 17 officers. Lander County is building a new jail, which is scheduled to be completed in 1999. The new facility will have a capacity of 50, in comparison to a capacity of 7 in the present jail. The Nevada Highway Patrol maintains a substation in Battle Mountain with 5 officers (BLM 1996a; Tri-County Development Authority 1996b; JBR 1995 and 1999).

Fire protection in the region is provided by local, state, and Federal agencies. The Winnemucca City Fire Department, with 24 volunteers (2 of whom are Emergency Medical Technicians), handles all fires within Winnemucca city limits. The Winnemucca Rural Fire Department, with 25 volunteers (2 of whom are Emergency Medical Technicians), is responsible for an area of 230 square miles around the town of Winnemucca, and has a mutual aid agreement with the BLM. The Battle Mountain Volunteer Fire Department has 24 firefighters, 10 of whom are Emergency Medical Technicians, and owns 6 trucks equipped with first aid supplies. The department is generally responsible for the northern half of Lander

County, and has a mutual aid agreement with the BLM and Nevada Division of Forestry. The most common types of fires in the area are wildland fires. The departments also respond to accidents, structural fires, and hazmat incidents. The Nevada Division of Forestry is equipped to fight wildland fires. It is directly responsible for fighting fires on state lands, and assists local and Federal agencies under mutual aid agreements. Both the U.S. Forest Service and BLM provide fire fighting capabilities on Federal lands (BLM 1996a; Tri-County Development Authority 1996b; JBR 1995).

**Medical Services**

Medical services in Humboldt County are provided by the Humboldt General Hospital, located in Winnemucca. The hospital has 22 acute care beds and 30 long-term care beds, and services include an intensive care, obstetrics, coronary care, out-patient surgery, and emergency room. Several renovations and additions were completed in 1995, including a Skilled Nursing Facility. The hospital also manages Community Health and Home Health offices. The medical staff includes 3 family practice staff, 1 general practice staff, 6 family physicians, 1 surgeon, 1 internist, 25 registered nurses, and 11 licensed practical nurses. In addition, specialists make routine visits to provide additional services. Emergency transportation services are provided by the Humboldt County Volunteer Ambulance Corps, under the jurisdiction of the hospital. In 1997, an expansion of ambulance facilities was completed, including a conference room, additional bays, sleeping quarters, and an office for the EMS coordinator. Mental health services are provided by the Winnemucca Mental Health Center. Demand for services was high in 1995, with a 3- to 4-week waiting list; however, the opening of additional small offices in surrounding communities (Lovelock and Battle Mountain) in 1997 alleviated some of the pressure. Home Health Services of Nevada has an office in Winnemucca and provides at-home nursing care. Winnemucca also has 5 dentists and 2 physical therapists (BLM 1996a; Tri-County Development Authority 1996b; JBR 1995 and 1999).

Medical services in Lander County and Battle Mountain are provided primarily by the Battle Mountain General Hospital and Nursing Home. The hospital provides 24-hour services in emergency, laboratory, x-ray, teleradiology, respiratory therapy, acute care, and long-term care. In 1996, an expansion was completed which included a new patient wing with 23 beds (16 long-term care and 7 acute). In 1997, the second phase of the project was completed, which moved the clinic into the existing hospital's patient wing. The hospital staff of 63 members consists of medical doctors in family practice, internal medicine, emergency, teleradiology, and pathology, as well as medical technologists and technicians, physical and respiratory therapists, and numerous other nursing and administrative staff members. The Battle Mountain Medical Clinic offers services in family practice, internal medicine, and some minor surgery. Mental health services are provided by the Battle Mountain Mental Health Center, a sub-satellite of Winnemucca Mental Health Center. Home Health Services of Nevada has a location in Battle Mountain and provides skilled nursing care, home health aides, homemaker services, hospice care, physical therapy, medical social work, and speech therapy (JBR 1999).

### 3.12.1.4 Government and Public Finance

**County Governments**

Both Humboldt and Lander counties utilize a commissioner form of government; Humboldt has five elected commissioners and Lander has three. The counties administer many services, including fire protection, roads, recreational facilities, library, water supply, wastewater treatment, and planning for their respective jurisdictions. The county governments are primarily supported by ad valorem (property tax) and sales tax revenues. The counties also receive taxes on the net proceeds of mines, assessed at the same ad valorem rate as other property taxes within each respective taxing district. Net proceeds and property

tax revenues provided for approximately 26.1 percent of Humboldt County total revenues in fiscal year 1994-95 and 40.7 percent of Lander County total revenues in fiscal year 1995-96. Intergovernmental sources, which are primarily composed of sales tax revenues, provided approximately 60.5 percent of Humboldt County revenues, and 59.3 percent of Lander County revenues. The largest expenditures for Humboldt County are public safety, general governmental functions, public works, and the judiciary, comprising a combined total of 77 percent of total county expenditures in the 1994-95 fiscal year. The largest expenditures for Lander County are public works, general governmental functions, public safety, and culture and recreation, comprising a combined total of 84 percent of total county expenditures in the 1995-96 fiscal year (Tri-County Development Authority 1996a, 1997).

**Tax Revenues**

Property taxes are determined from the assessed valuation of properties and the ad valorem tax rate. The assessed valuation is 35 percent of the estimated full value of the property. Trends in assessed valuation and taxable sales for Humboldt and Lander Counties are shown in Table 3-26. The total assessed valuation in Humboldt County in 1997 was $458,690,000, fluctuating in the previous 5 years. The total assessed valuation in Lander County in 1997 was $215,372,000, which also fluctuated in the previous five years. The ad valorem tax rate in Humboldt County ranged from $2.439 to $3.409 per $100 of assessed valuation in the 1994-95 fiscal year. The ad valorem tax rate in Lander County ranged from $3.01 to $3.28 per $100 of assessed valuation in the 1996-97 fiscal year. Higher rates are assessed within cities than in other areas of the counties (Tri-County Development Authority 1996a, 1997; Nevada Department of Administration 1999).

The assessed valuation of mining properties in Humboldt County was $245,514,000 in 1997, or more than one half of the county's total assessed valuation (Table 3-26). This value increased substantially in the previous 4 years, averaging 13.6 percent annual growth. The assessed valuation of mining properties in Lander County was $110,288,000 in 1997, or more than one-half of the county's total assessed valuation. This value increased by 39 percent over the 1996 assessed valuation of mining properties, but decreased in 2 of the previous 3 years. In addition to property taxes on real property, mines pay a net proceeds tax on minerals extracted. Net proceeds are calculated as the gross proceeds less allowable expenditures, and are taxed by the state's centrally assessed property tax division. This tax is currently $5 per $100 (if net is over $4 million). Counties receive revenues equal to their ad valorem rate where the mineral was produced, applied to the net proceeds, and the State of Nevada receives the balance. For example, in Lander County, the ad valorem rate is $3.01 per $100. Therefore, the county receives $3.01 for every $100 of net mining proceeds generated in the county. The state receives the balance of $1.99. Net proceeds taxes are distributed within counties the same way as other property taxes (Nevada Department of Administration 1999).

Taxable sales increased steadily in Humboldt County from 1993 to 1996, to a 1996 level of $400,494,000. Lander County's taxable sales decreased from 1993 to 1994, then increased an average of 28 percent per year from 1994 to 1996. Sales tax rates in Humboldt and Lander Counties in 1996 were both 6.50 percent, with 2.0 percent accruing to the state. The remaining portions accrue to local school support, and county and city government (Nevada Department of Administration 1999; Tri-County Development Authority 1996a, 1997).

Mining directly contributes to local government revenues through property tax payments on mining property, net proceeds taxes, and sales taxes on local purchases. Additionally, revenues are contributed through employees' spending of wages, which generates sales taxes, and payments on personal property. Marigold Mine has contributed to local government revenues in the above-described ways throughout its operational period. Direct contributions in 1998 are estimated at $141,000 in property taxes, and $450,000 in sales taxes (within the State of

**Table 3-26**
**Trends in Assessed Valuation and Taxable Sales - Humboldt and Lander Counties**

| | FY 1992-1993 | FY 1993-1994 | FY 1994-1995 | FY 1995-1996 | FY 1996-1997 |
|---|---|---|---|---|---|
| Humboldt County | | | | | |
| Taxable Sales | $282,901,000 | $288,019,000 | --- | $400,494,000 | --- |
| Assessed Valuation | $474,371,000 | $505,350,000 | $544,309,000 | --- | $458,690,000 |
| Assessed Valuation of Mining Properties | $148,953,000 | $161,335,000 | $175,182,000 | $194,728,000 | $245,514,000 |
| Lander County | | | | | |
| Taxable Sales | $82,584,000 | $78,378,000 | $102,990,000 | $128,268,000 | --- |
| Assessed Valuation | $156,637,000 | $252,779,000 | $244,630,000 | $241,975,000 | $215,372,000 |
| Assessed Valuation of Mining Properties | $88,501,000 | $81,221,000 | $78,101,000 | $79,318,000 | $110,288,000 |

Source: Tri-County Development Authority 1996a, 1997.

Nevada) (Back 1999). Indirectly, employees' spending of wages has generated sales taxes and personal property taxes. From the 1998 payroll of $4.5 million, it can be estimated that approximately 70 percent of employees' wages (or $3.15 million) is disposable income, with a substantial portion spent locally on goods and services. Applying an average sales tax rate of 6.5 percent, this yields a maximum of $205,000 in sales tax revenues. Property taxes and net proceeds taxes accrue to the state and to Humboldt County. Sales taxes accrue to the state, Humboldt and Lander Counties, and cities within the region. Other benefits are contributed by the mining industry through secondary economic activities and employment generated by mining activity.

## 3.12.2 Environmental Consequences

### 3.12.2.1 Proposed Action

The Proposed Action would extend the life of the mine an additional 5 years, through ***2007***. Reclamation would continue until ***2017***. An average construction work force of 25 to 30 would be employed during the initial construction period (***2001*** to ***2005***). Current employment at the mine is approximately ***100*** employees. Peak employment is not expected to exceed 113 through ***2007***. The primary social and economic impacts of the proposed project would be the impacts of increases in the construction and operations work force and the associated effects on employment, income, and public finance. In addition, this section evaluates the continuation of economic benefits provided by the operation of the Marigold Mine, and the effects of eventual mine closure.

New employees hired for construction and operation are expected to be hired from local sources, and are not likely to induce noticeable changes in the level of public services available or required. The new employment during the construction and operations phases would benefit local communities by providing new income and resulting increases in purchases and sales taxes in the area. The mine expansion would provide for the on-going and increased community benefits of employment, income, and tax revenues for the state and local counties and cities. A reclamation work force of 13 employees would be maintained for the initial 2-year reclamation period; a minimal work force would be maintained for reclamation activities through ***2017***. With the phasing out of mine employment and the closure of the mine, income, tax revenues, and other economic benefits generated by mine operation would be discontinued.

As required by Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, the proposed project was evaluated for issues relating to the social, cultural, and economic well-being, and health of minorities and low income groups. Such issues are termed environmental justice issues, and none were identified for the proposed project. Social and economic impacts of the proposed project would not affect minority or low-income groups disproportionately.

**Population and Demography**

**Construction/Operations**. Approximately ***13*** or fewer additional employees would be hired for the construction and operations phases of the project. The total work force is not expected to exceed 113 employees during the construction and operational life of the mine. Construction would be intermittent but ongoing from ***2001*** through ***2005***. Therefore, some employees would be expected to work in both construction and operational capacities during this time. Local skilled labor is abundant as a result of recent layoffs at other mines, and local unemployment rates are relatively high. Therefore, local hiring is expected to comprise 100 percent of new employment, if possible, or approximately ***13*** or fewer workers (Back 1999).

Population increases could be induced by the secondary economic activity generated through construction and operations employment. In other words, the spending of workers' wages and purchases made by the mining company or

contractors during the construction and operations phases would support additional jobs in other employment sectors. Because construction and operations would occur concurrently from ***2001*** through ***2005***, the standard multiplier developed for mine operations is used to estimate secondary employment generated during this period. A standard multiplier of 1.74, from John Dobra's The Economic Impacts of Nevada's Mineral Industry (1989), is used to estimate secondary employment (0.74 secondary jobs for every one operations job). Using this multiplier, an increase of ***13*** direct jobs could generate an additional ***10*** secondary jobs in the local economy. Secondary jobs associated with mine expansion are not likely to require outside recruitment because the area's labor supply is abundant, as reflected in the 1998 unemployment rates of 10.3 and 6.5 percent in Lander and Humboldt counties, respectively.

Direct and indirect employment during construction and operations activities would not be expected to induce population changes in the area due to the availability of local labor sources.

**Reclamation.** During the reclamation period, beginning in ***2008***, operations employment would be phased out. A work force of 13 employees would be maintained for reclamation activities from ***2008*** through ***2010***; a minimal work force would be maintained for reclamation activities through ***2017***. Population could begin to decline in the area beginning in ***2008***, if workers do not obtain work at other mines or in other suitable positions within a reasonable time period following lay-offs. The extent of the potential population changes are difficult to estimate, as it is highly dependent on the prevailing economic conditions and availability of work when employment is phased out.

**Economy, Employment, and Income**

The principal economic effects of the Proposed Action would be an increase in employment in Lander and Humboldt counties and additional mining operations employment of up to ***13*** employees through the year ***2007***. New income would be generated from the new construction and operations jobs, a significant portion of which would be spent in the local economy. Secondary jobs, primarily in the services and trade industries, would continue to be supported by mining employment in Humboldt and Lander counties. Additional secondary employment and income would be induced by the new construction and operations positions. Employment and income would be phased out during reclamation.

**Construction/Operations**. As the construction and operations work force would increase by ***13*** or fewer employees to approximately 113 workers at peak employment, the primary economic impacts associated with the proposed project would be an increase in economic, employment, and income benefits generated by the Marigold Mine. The current operations employment of ***100*** positions provides approximately ***5*** percent of Lander County mining employment, and 2 percent of Humboldt County mining employment. Using a multiplier of 0.74 ("Indirect Contributions of Mining", Section 3.12.1.2, Economy, Employment, and Income), estimated secondary employment of ***10*** positions would be supported by additional direct employment during construction and operations. These positions would occur primarily in the services and trade sectors and, because the area's local labor supply is abundant, it is anticipated that secondary employment would be supplied by local sources. Unemployment rates in Humboldt and Lander counties may be slightly reduced by new direct and indirect employment generated by construction and operation of the proposed project.

An average annual payroll of $4.5 million is estimated for the years 1999 through ***2007***. The projected average annual wage is approximately $45,000. The total payroll through the life of the project is estimated at $36 million. A standard multiplier of 1.57, from John Dobra's *The Economic Impacts of Nevada's Mineral Industry* (1989), is used to estimate the total earnings generated through mining activity, as income cycles through the economy ($1.57 in total earnings within the state for every mining payroll dollar). Applying this multiplier to the total payroll and benefits paid through

the life of the project ($36 million) yields estimated total earnings of $56.5 million within the State of Nevada. These earnings are generated by the respending of workers' income, and direct purchases of goods and services by the mining company, both of which support secondary businesses and industries within the economy. Total purchases made by Marigold Mine through the life of the project are estimated at $37.8 million, with 100 percent of these purchases made within the State of Nevada, if possible.

**Reclamation.** Mine closure in ***2008*** would cause a reduction in Humboldt and Lander county total employment and a reduction in mining sector employment. Unemployment could temporarily increase, depending upon the amount and types of available work at the time of closure. The loss of mining employment in the county would represent a net income loss, as mining jobs typically pay the highest wages of any employment sector. The earnings generated by mining employment and the secondary effects of spending by workers and purchases of goods and services would be reduced through the reclamation period, and eventually terminate when all employment and mining activity cease.

**Housing**

**Construction.** No changes in housing demand are anticipated for the construction activities, as construction personnel are expected to be hired from existing local labor sources. Housing demand due to construction of the proposed project would remain roughly the same as current demand.

**Operations.** No changes in housing demand are anticipated for the operations phase, as personnel are expected to be hired from existing local labor sources. Housing demand due to operation of the proposed project would remain roughly the same as current demand.

**Reclamation.** Housing demand in the area could potentially decrease at the end of mine life. The extent of this decrease would depend upon how many workers locate alternate work following lay-offs and choose to remain in the area. If workers leave the area, housing demand would decrease, vacancy rates could increase, and housing costs in the area could decrease slightly. This would impact primarily Battle Mountain and Winnemucca, as 98 percent of current Marigold Mine employees reside in or near those two communities. Housing markets in other local communities would be affected only slightly.

**Community Services**

**Construction.** No impacts to community services would occur during the construction activities of the proposed project. Demand for services would continue at current levels.

**Operations.** No impacts to community services are expected to occur during operation of the proposed project. Demand for services would continue at current levels.

**Reclamation.** Demand for services could decrease during the reclamation period, depending on the number of workers who leave the area following lay-offs. The effects would be proportionate with the number of workers and their families who leave. If a large number leave the area, effects would be noticeable in Winnemucca and Battle Mountain. As workers leave the area, demand for utilities, law enforcement, fire protection, and medical services would decrease. This would be beneficial in reducing demand loads where systems of delivery are strained. It would be detrimental where additional demand supports the facility, such as a hospital. The number of school-aged children also would decrease, leading to more space in local schools. A negative impact of reduced population is that it decreases the tax base, which goes toward supporting public services and funding capital improvements.

**Government and Public Finance**

The primary impacts of the proposed project on public finance would be the benefits of increased sales

taxes during construction and operation, the continuation of economic contributions provided by on-going operation of the mine, and the loss of tax revenues following mine closure.

**Construction.** During construction activities, additional sales taxes would be generated in the area from employees' spending of wages and contractors' purchases of goods and services. Sales taxes provide substantial revenues for both counties and cities, and portions also accrue to the State of Nevada. Indirect sales tax revenues would be greater than the direct amount as income cycles through the economy (i.e., money is respent on goods and services).

**Operations.** Continued operation of the Marigold Mine would provide for the on-going benefits of property tax, net proceeds tax, and sales tax revenues for Lander County, Humboldt County, and local city governments. Estimated property tax payments are $800,000 through the life of the project (Back 1999). Property taxes would accrue to Humboldt County. Mining currently provides a substantial tax base for Humboldt County, of which the Marigold Mine is a primary part. Mining properties currently provide for approximately 54 percent of total assessed valuation in Humboldt County. The assessed valuation of properties in the county has changed very little in since 1990, indicating that the tax base has remained essentially the same. Continued operation of the mines located in the county would provide stability in the tax base.

Net proceeds taxes also contribute significantly to county revenues. Together, net proceeds taxes and property taxes provide approximately 26 percent of Humboldt County revenues. Continued operation of the mine would continue this revenue source for the county. Projected net proceeds contributions from Marigold Mine are expected to total $400,000 through the life of the project (Back 1999). Portions of the net proceeds taxes would accrue to the State of Nevada.

Sales taxes would continue to accrue from workers' spending of wages in the local economy, and the mine's purchases of goods and services. Projected sales tax payments by the mine within the State of Nevada from 1999 through the end of the reclamation and monitoring period total $2.5 million. Projected payroll salaries and wages are $4.5 million per year from 1999 through ***2007***, and $36 million for the life of the project. If 70 percent of this is disposable income spent locally on goods and services, direct sales taxes of a maximum of $205,000 per year, or $1.6 million total, would result (utilizing a sales tax rate of 6.5 percent). Sales taxes provide revenues for the state, counties, and cities. Cities, in particular, are highly dependent upon sales tax revenues. A large portion of the sales tax revenues resulting from spending of payroll income would occur in the communities of Winnemucca and Battle Mountain, where most of the workers live and, therefore, spend their income. In addition, the continued support of commercial and residential activity in Winnemucca, Battle Mountain, and other local communities would continue to contribute to the tax base and provide property taxes for local cities and counties.

**Reclamation.** Beginning in ***2008***, with mine closure, tax revenues from the Marigold Mine would begin to decrease substantially. Humboldt County would experience significant reductions in property tax and net proceeds tax revenues. This could cause budget constraints and necessitate finding alternate sources of revenues or altering county budget expenditures. Sales tax revenues would decrease for Humboldt and Lander Counties, Winnemucca, Battle Mountain, and other local communities. The loss of these revenues would have negative impacts on local government entities.

#### 3.12.2.2 8-South Partial Pit Backfill Alternative

The social and economic impacts of this alternative would be the same as those described for the Proposed Action.

#### 3.12.2.3 No Action Alternative

Under the No Action Alternative, mine operations would cease after ***2001***. This would result in adverse

social and economic impacts in the form of lost employment, personal income, tax revenue, and other economic benefits contributed by the Marigold Mine. The current employment of ***100*** operations workers would be discontinued, causing a loss of direct and indirect employment and income benefits in the local economy. A minimal staff would be maintained through the reclamation period. With mine closure, tax revenues would no longer be accrued from the mine, including property taxes, net proceeds taxes, and sales taxes. This would adversely impact the Humboldt County and Lander County governments, the communities of Winnemucca and Battle Mountain, and the local school districts, resulting in a loss of funding, and temporarily causing some budget constraints. Purchases of goods and services in the local economy would be reduced, and eventually discontinued. The future economic benefits of mine operation would not be obtained.

Workers would likely attempt to acquire work at other mines in the area, depending on the jobs available at that time. Unemployment rates would likely increase temporarily. If jobs were unavailable, the unemployed workers would either remain in the area, continuing their demands on community services, or would relocate to another area for employment. If many workers were forced to relocate, there would be a decrease in local populations, and an associated loss of economic activity, sales taxes, and reduced demand for housing and community services.

### 3.12.3 Cumulative Impacts

The cumulative assessment area encompasses those counties and communities wherein the social and economic impacts from regional development would be expected to occur. Given geographical and demographic characteristics, impacts from the Proposed Action would occur in Lander County, Humboldt County, Winnemucca, Battle Mountain, and to a lesser extent, other small communities near the mine site. These areas define the socioeconomics cumulative assessment area for the project.

Socioeconomic impacts resulting from reasonably foreseeable future actions would depend on the schedule and scope of potential new mining activities and any other large-scale development projects in the vicinity of the proposed project. Continued mining operations and expansions, in particular, may extend the types of beneficial and negative impacts similar to those described for the proposed project. In addition, the timing of mine closures also could compound the effects of mine shut-downs. The current major mining projects and reasonably foreseeable future projects, with their estimated employment numbers, are listed in Table 2-9 and illustrated on Map 2-7.

The cumulative assessment area has long been dependent on the mining sector for economic activity and employment. Likewise, it is the mining sector that has done much to define this region. Rapid growth over the last 15 years is largely attributable to the increased mining in the area. Cumulative impacts from mining, therefore, are not a new phenomenon. The impacts include a substantial infusion of economic resources, which has been beneficial. Mining has contributed substantially to the regional economic base, providing jobs, high wages, tax revenues, and indirect economic benefits. This has fueled economic expansion and helped to provide capital for infrastructure development in local communities, a foundation for further economic growth (BLM 1996a; Nevada Bureau of Mines and Geology 1991).

However, with the population growth attributable to mining, development pressures also have become apparent. Past cumulative impacts have resulted in a limited housing market, increased crowding in schools, and excess demand on some community facilities and services. The actual impacts experienced in an area largely depend on the relationship between the amount and timing of the housing or service demand, and the timing of the construction activity and tax revenues available that could fund the needed capital improvements or services expansions. Housing construction is often

slow to respond to increased demand, sometimes with a lag time of several years between the initial demand, construction, and availability of additional housing units. In addition, the increased demand must be perceived as long-lasting for the developers to respond with additional construction. In the realm of public services, new projects can produce public revenue surpluses, but there is an initial lag of 1 to 2 years before the revenues are available for needed expenditures. Therefore, local governments may temporarily experience deficits.

Several issues have been identified in the cumulative assessment area, with respect to local housing markets and public services, that could be compounded by any increases in population induced by the reasonably foreseeable future actions. Specifically, 1) housing markets could be further impacted by increased mining activity, 2) law enforcement services in the area are currently short-staffed, and 3) many of the area schools are at or near capacity. In addition to the Marigold Mine expansion, the three reasonably foreseeable future actions identified on the list, the Phoenix Project, and the Lone Tree Mine Modification to Plan could further impact these resources by bringing new population to the area for construction and operations work forces. No definite schedules currently exist, so it is difficult to predict the extent of the cumulative impacts, if any.

The Phoenix Project would require 210 operations personnel. The Lone Tree Mine Modification would require approximately 100 employees. If these projects induce population increases at the same time that the Marigold Mine is employing its construction or operations work force, additional impacts to local housing markets and increased pressure on local law enforcement services and schools could occur. Additional impacts on the temporary housing market would increase the competition with tourists for hotel/motel rooms, recreational vehicle sites, and camping areas. Increased demands on local law enforcement agencies would reduce service levels for the current population and increase the pressure for additional funding for services. Increased school enrollments would require additional expenditures by local school districts and increase the pressure for new infrastructure in facilities that are reaching capacity.

Positive benefits also would be contributed by the cumulative mining projects. Lone Tree Mine is located in Humboldt County, and the Phoenix Project is located in Lander County. These projects would add to the mining employment and income in Humboldt and Lander counties and contribute to the tax base. These benefits would continue through the life of the mines. In addition, sales tax revenues would be further increased in local communities where workers reside (primarily Winnemucca and Battle Mountain).

Both present actions and reasonably foreseeable future actions can contribute to the scale of the impacts resulting from mine closure. Mine shut-down dates are highly subject to change as mines continue exploration and expansion activity, which can extend the mine life. If several mines in the cumulative assessment area close simultaneously or within a relatively short period of time from each other, the negative effects of unemployment, loss of income, decreasing population, and loss of tax base can be compounded. These cumulative impacts are speculative, however, given the high variability in mine lifetimes. In addition, prevailing economic conditions at the time, and the start-up of other mines have the potential to off-set these impacts.

### 3.12.4 Potential Mitigation and Monitoring

No mitigation and monitoring measures are recommended for social and economic resources.

The BLM can and does encourage local, county, and state governments or agencies to initiate discussions with the project proponent on the basis of the analysis presented in this EIS. The establishment of a dialogue based on mutual advantage and understanding, and a commitment to a shared responsibility for resolution of the potential impacts associated with project development, could lead to

the preparation and implementation of mitigation measures which are advantageous to all parties.

### 3.12.5 Residual Adverse Impacts

Residual adverse impacts to housing and community services would be minor. The impacts associated with mine closure are largely unavoidable. The extent of these impacts would depend upon other economic activities in Humboldt and Lander counties, the development of the tax base, and prevailing economic conditions at the time of mine closure.

# 3.13 Hazardous Materials

## 3.13.1 Affected Environment

The potentially affected environment resulting from the presence of hazardous materials and waste includes air, water, soil, and biological resources. The environment could be affected in the event of an accidental release of hazardous materials or wastes during transportation to and from the project area or during storage and use at the project site.

GMMC currently transports process- and mining-related chemicals to the mine by truck from numerous locations within Nevada and surrounding states. All of the hazardous materials are transported along I-80, which is located adjacent to the Humboldt River both east and west of the site. The hazardous materials that are currently used at the site are listed in Table 2-4.

**Hazardous Materials**

The existing operations include transporting, handling, storing, using, and/or disposing of the following materials classified as hazardous by 49 CFR 172.101:

- Diesel fuel, gasoline, propane, petroleum oils, lubricants, ethylene glycol, acetylene, oxygen, and solvents used to operate and maintain equipment;
- Sodium cyanide, sodium hydroxide, calcium oxide (lime), hydrochloric acid, flocculent, and antiscalant used in the gold extraction processes;
- Ammonium nitrate and explosives used for blasting in the open pit; and
- Various by-products and chemicals classified as hazardous waste from the assay laboratory.

Of the chemicals cited above, sodium cyanide, sodium hydroxide, hydrochloric acid, and ethylene glycol are hazardous substances that also are listed in the 40 CFR 302.4 of the CERCLA and the appendices of the Superfund Amendments and Reauthorization Act. There are established reportable quantities for these chemicals, which apply to the reporting requirements associated with a release of each chemical. Petroleum products also have an established reportable quantity, but are excluded as hazardous substances under CERCLA Section 101(14). A summary of the CERCLA reportable quantities for those chemicals discussed above is presented in Table 3-27. The reportable quantity for petroleum products is 25 gallons released to the ground surface.

**Transportation**

Trucks are used to transport a variety of non-hazardous materials as well as hazardous materials to and from the project site. Based on their hazardous characteristics, volume, and number of deliveries, the materials of greatest concern are sodium cyanide, sodium hydroxide, and diesel fuel.

Sodium cyanide is considered to be the most hazardous material to be delivered to the site, due to the toxic nature of the chemical. Sodium cyanide is transported to the mill monthly in 59,000-pound loads and to the heap leach facility 2 times a month in 59,000-pound loads. Another potentially hazardous chemical delivery is that of corrosive sodium hydroxide, which is delivered every 10 days in 48,000-pound loads. Diesel fuel also is considered to be one of the most hazardous materials transported to the site. Although diesel is not among the most toxic of materials used at the site, it is delivered in the greatest quantity and frequency (two 10,000-gallon loads per week).

The sodium cyanide used at the site is supplied by FMC of Battle Mountain, Nevada, located approximately 17 road miles from the site. The

**Table 3-27**
**CERCLA Reportable Quantities**

| Material | CERCLA Reportable Quantities (pounds) |
|---|---|
| Sodium Cyanide | 10 |
| Sodium Hydroxide | 1,000 |
| Hydrochloric Acid | 5,000 |
| Ethylene Glycol | 5,000 |
| Solvents | 10 – 5,000 |

sodium hydroxide is supplied by Sierra Chemical of Battle Mountain, Nevada, also located approximately 17 road miles from the site. Diesel fuel is supplied by Al Park Petroleum of Elko, Nevada, located approximately 104 road miles east of the site. Sodium cyanide, sodium hydroxide, and diesel fuel are transported directly to the mine site on I-80 from the east.

The risk of an accident involving deliveries of these three substances was evaluated using Hazardous Materials Transportation Risk Analysis (Rhyne et al. 1994). According to these national statistics, the average rate of truck accidents on a rural freeway resulting in a release of the contents is 0.12 accidents per million miles traveled. Using these statistics, the probability of a transportation accident resulting in a release of the three chemicals was evaluated over the proposed extended life of the project:

**Sodium Cyanide:**

190 truck deliveries x haul distance of 17 miles x 0.00000012 accidents per mile traveled = 0.0004 total releases

**Sodium Hydroxide:**

180 truck deliveries x haul distance of
17 miles x 0.00000***12*** accidents per mile traveled = ***0.0004*** total releases

**Diesel Fuel:**

550 truck deliveries x haul distance of
104 miles x 0.00000012 accidents per mile traveled = 0.007 total releases

The above analysis indicates that the probability of an accident over the extended life of the project, during the transport of any of these substances, would be low. There have been no releases of any of these substances during transportation and mine operation to date.

All hazardous substances are transported by commercial carriers or vendors in accordance with the requirements of Title 49 of the CFR. Carriers are licensed and inspected, as required by the Nevada Department of Transportation and the USDOT. Tanker trucks have a Certificate of Compliance issued by the Nevada Motor Vehicle Division. These permits, licenses, and certificates are the responsibility of the carrier. Title 49 of the CFR requires that all shipments of hazardous substances be properly identified and placarded. Shipping papers must be accessible and must include information describing the substance, immediate health hazards, fire and explosion risks, immediate precautions, fire-fighting information, procedures for handling leaks or spills, first aid measures, and emergency response telephone numbers.

In the event of a release off the project site, the transportation company would be accountable for response and cleanup. Each transportation company

is required to develop a *Spill Prevention, Control, and Countermeasures Plan* to address the materials it would be transporting. Local and regional law enforcement and fire protection agencies also may be involved initially to secure the site and protect public safety. Title 49 of the CFR requires that the carrier notify local emergency response personnel, the National Response Center (for discharge of reportable quantities of hazardous substances to navigable waters), and the USDOT in the event of an accident involving hazardous substances.

**Storage and Use**

GMMC has developed an integrated *Emergency Response Plan* to address, among other things, release of fluids from mine facilities. Over the life of the project, the probability of minor spills of materials such as lime or oils and lubricants (from loading or unloading activities) is relatively high. The plan addresses the following items:

- Accidents/Medical Emergencies;
- Fires/Explosions;
- Chemical Releases (fluid management and spill control);
- Natural Disasters;
- Evacuation Plans;
- Power Failure/Outage; and
- Criminal Activities.

The section on chemical releases contains procedures for the control of leaks or spills of sodium cyanide (solid and liquid), caustic soda, hydrochloric acid, lime, anti-scalent, propane, diesel or gasoline, and other petroleum products. The section also contains the following:

- Fluid management plan describing the containment and leak detection systems to control and monitor process fluids at the facility;
- Monitoring plan describing the inspection of process areas for potential leaks and sampling of monitoring ports once per quarter to detect migration of process fluids from the mill, leach pads, tailings pond and other ponds;
- List of reportable quantities;
- Notification and reporting requirements; and
- Location and contents of spill kits and other protective equipment.

Operation in accordance with the *Emergency Response Plan* would assist in keeping spills localized and contained to allow for efficient clean up. GMMC has the necessary spill containment and cleanup equipment and trained personnel available at the site to quickly respond to minor releases.

Hazardous materials storage tanks have secondary containment sufficient to hold 110 percent of the volume of the largest tank within the containment system. Management of all tanks and vessels comply with manufacturer's recommendations, state and Federal regulations, and best management practices.

All hazardous substances are handled in accordance with applicable MSHA or Occupational Safety and Health Administration regulations (Titles 30 and 29 of the CFR). The hazardous substances to be used are handled as recommended on the manufacturer's MSDS. With the above-listed design features and operational practices in place, the probability of a major release occurring at the site is low.

In the event of a major or minor spill occurring on-site, GMMC would follow procedures presented in the *Emergency Response Plan* that establishes procedures for preventing, controlling, and reporting environmental releases within or from facilities located at the site. All spills, including transportation and loading/unloading related spills occurring on-site, are cleaned up or neutralized and reported, as required, to the Nevada Division of Emergency Management, the NDEP, the Nevada Bureau of Mining Regulation and Reclamation, the USEPA, the National Response Center, the BLM, the Humboldt County Department of

Public Works, and Lander County Emergency Planning.

**Disposal and Recycling**

Non-hazardous solid waste generated on the site is disposed in an approved Class III on-site landfill. Used tires are either recycled by the suppliers ***or buried in the waste rock dump***. Used equipment such as batteries, alternators, starter motors, etc. are recycled for remanufacture. Slag from GMMC's on-site lab is recycled at Just Refinery in Reno/Sparks, Nevada. Crucibles and cupels from the lab are sent to the U.S. Ecology hazardous waste landfill in Beatty, Nevada, for disposal. GMMC is a small quantity generator (SQE) of hazardous waste. Used petroleum products, antifreeze, and freon are transported off-site to approved recycling facilities.

**Effects of a Release**

The environmental effects of a release depend on what is released, how much is released, and where it is released. The accident/release statistics previously calculated assume a hazardous material, but do not address volume or location. Potential release scenarios could include a small amount of diesel fuel spilled during transfer operations at the site or the loss of several thousand gallons of sodium hydroxide, diesel fuel, or sodium cyanide into a drainage.

Sodium hydroxide spilled onto the ground or into a water body has the potential to cause severe short-term damage to localized terrestrial and aquatic habitats. A sodium hydroxide release into a stream or other water body could cause more severe effects, since it has the potential to migrate much farther from the immediate spill site, raise the pH of the water, and potentially result in a reduction in populations of aquatic invertebrates, amphibians, and fish. Base spills, such as sodium hydroxide, may be neutralized by acidic soils.

A release of diesel fuel in high concentrations would damage vegetation and, although unlikely, could ignite and result in a range fire. A spill into a water body would contaminate the water and sediment, possibly impacting local aquatic populations. Because cleanup actions would take place immediately, diesel contamination would not likely result in long-term increases in various hydrocarbons in soils, surface water, or groundwater.

The effects of a sodium cyanide release could be highly variable, much more so than a release of sodium hydroxide or diesel fuel, depending on the volume of the release, the location of the release (e.g., dry upland area, wet meadow area, or flowing stream area), the organisms exposed, and the chemical conditions at the release location. Sodium cyanide solution decomposes rapidly when in contact with the atmosphere and develops poisonous and flammable hydrogen cyanide gas. Environmental effects of a cyanide spill or leak would be limited in extent and time of contamination due to the rapid degradation of cyanide into benign elements when exposed to direct sunlight or oxygen.

A large-scale release of fuel, acid, base, or cyanide could have implications for public health and safety. The location of the release would again be the primary factor in determining its significance. A release in a populated area could have effects ranging from simple inconvenience during cleanup to potential loss of life. The probability of a release anywhere along a transportation route is very small; the probability of a release within a populated area is smaller; and the probability of a release involving an injury or fatality is smaller still. USDOT statistics show that between 1983 and 1992, in the State of Nevada, an average of 0.03 injuries or deaths occurred for each hazardous materials highway incident (USDOT 1993). Based on these statistics, it is not anticipated that a release involving severe effects to human health or safety would occur during the life of the project. None of the process chemicals or fuels to be used in large quantities are carcinogenic; therefore, there would be no increases in cancer risk expected as a result of extension of the mining activity.

The release of a hazardous material or waste into a sensitive area (such as stream, wetland, or populated

area) is judged to be highly unlikely. Again, depending on the material released, the amount released, and the location of the release, an accident resulting in a release could impact soils, water, biological resources, and people.

**Response to a Release**

Sodium hydroxide, diesel fuel, and sodium cyanide are designated as "hazardous substances" for purposes of the release reporting requirements of CERCLA (40 CFR Table 302.4). All releases of a "reportable quantity" of such hazardous substances must be reported to the National Response Center and the Nevada Division of Emergency Management. In addition, guidelines used by the NDEP require that areas affected by a release of cyanide be cleaned up until the concentration of cyanide in the soil is less than 0.2 milligram of cyanide per kilogram of soil. Releases of hazardous substances and petroleum products on public lands must be reported to the BLM. GMMC would comply with all provisions of Federal and state law and ensure that all releases of hazardous substances would be reported promptly and thoroughly cleaned up.

In the event of a release en route to the site, the transportation company is responsible for response and cleanup. Law enforcement and fire protection agencies also may be involved to initially secure the site and protect public safety.

Hazardous materials transporters are required to maintain an emergency response plan, which detail the appropriate response, treatment, and cleanup for a material spilled onto land or into water. Any cleanup would be followed by appropriate reclamation regarding the disturbed area, which could include replacing removed soil and seeding the area to prevent erosion, and the return of the land to its previous use.

## 3.13.2 Environmental Consequences

### 3.13.2.1 Proposed Action

The Proposed Action would extend the life of the mine, resulting in continuation of the current hazardous materials use practices through the year ***2007***.

The potential for impacts to the environment exists with the presence of hazardous materials and wastes at the site. Environmental impacts could result from an accidental release of hazardous materials or wastes during transport to or from the site or a release related to use or storage at the site. The criterion for evaluating potential impacts by hazardous materials and wastes is the risk of a spill and resultant impacts to sensitive receptors along transport routes or exposure pathways.

Since the transportation frequency and volume would not change with the Proposed Action, no incremental increase in the transportation or use of hazardous materials or wastes would occur. The only additional risks resulting from expansion of the mine is extending the life of the project.

As previously discussed, the proposed mine expansion would require continued use and storage of hazardous materials. If some of the chemicals used at the site were to enter the environment in an uncontrolled manner, there could be associated direct or indirect adverse environmental effects. The effects of a release would depend on the substance, quantity, timing, and location of the release. The event could potentially range from a minor petroleum spill on the project site where cleanup equipment is readily available, to a severe release of sodium cyanide solution during transport. Some of the chemicals could have immediate destructive effects

on aquatic resources and water quality if a release were to enter a surface water body such as the Humboldt River. A hazardous material or waste release also could seep into the ground and contaminate the local groundwater. Depending on the proximity of such a release to populated areas or water supplies, the use of degraded water for human consumption could affect human health.

As discussed in Section 3.13.1, Affected Environment, over the proposed life of the project the likelihood of a release occurring during transport of hazardous materials to and from the site is low. The overall potential for a release of hazardous materials in association with transportation, storage, and use at the site also is considered to be low. Furthermore, the potential for a release that would result in significant adverse effects to human health or the environment is even lower.

#### 3.13.2.2 8-South Partial Pit Backfill Alternative

The 8-South Partial Pit Backfill Alternative would result in the same impacts as described for the Proposed Action.

#### 3.13.2.3 No Action Alternative

Under the No Action Alternative, the current hazardous materials transportation, storage, or use described for the Proposed Action would be discontinued after the year 2001.

### 3.13.3 Cumulative Impacts

Since the potential for accidents involving trucks delivering hazardous materials to the site is low, cumulative impacts resulting from continued shipment of hazardous materials to the Marigold Mine site is minimal. The cumulative effects of using and storing hazardous materials on the project site has been minimized by implementation of the *Emergency Response Plan*.

### 3.13.4 Potential Mitigation Measures

Additional mitigation measures, beyond the protection measures committed to by GMMC and discussed in Section 2.2.17, Hazardous Materials and Wastes, would not be needed.

### 3.13.5 Residual Adverse Effects

Residual adverse effects from the continued use of hazardous materials on the project site for the Proposed Action would depend on the substance, quantity, timing, location, and response involved in an accidental spill or release. Operation in accordance with the facility's *Emergency Response Plan* and prompt cleanup of spills minimizes the possibility of residual adverse effects due to hazardous materials.

# 3.14 Cultural Resources, Ethnography, and Paleontology

## 3.14.1 Affected Environment

### 3.14.1.1 Cultural Resources

The goal of cultural resource management is to maintain and enhance historic and prehistoric cultural resource values. Cultural heritage resources consist of prehistoric and historic archaeological deposits; structures of historic or architectural importance; and Native American traditional ceremonial, ethnographic, religious and burial sites. Prehistoric resources are physical locations with a cluster of features and/or artifacts that are a result of human activities occurring prior to written records. Historic resources are clusters of features and/or artifacts left by human activity occurring after written records were common.

Prehistoric properties found in the project area include lithic scatters, temporary camps, and isolated finds. Historic cultural resources in the project area are primarily related to mining and include trash middens and mine workings.

Analysis of cultural resources can provide valuable information on the cultural heritage of local peoples and regional populations. Cultural heritage resources are nonrenewable resources that are afforded protection by Federal, state, and local laws, ordinances, and guidelines. The following Federal legislation, policies, regulations, and guidelines have been enacted to protect cultural heritage resources and have been considered during review of the proposed project:

- The Antiquities Act of 1906 (PL 59-209) and the Archaeological Resources Protection Act of 1979 (PL-96-95).
- National Historic Preservation Act of 1966, as amended; Section 106 Compliance; 16 United States Code 470 et seq., and implementing regulations 36 CFR 800.
- American Indian Religious Freedom Act of 1978 (AIRFA).
- Native American Graves Protection and Repatriation Act of 1990 (NAGPRA).

**Cultural Setting**

The cultural setting discussion for the project region has been divided into prehistoric and historic periods, with the prehistoric period ranging from approximately 12,000 years before the present (BP) to the first arrival of Euroamericans.

**Prehistoric Period**. Archeologists divide the prehistoric period in the Great Basin region into the Pre-Archaic (approximately 12,000 BP to 7,000 BP) and the Archaic (approximately 7,000 BP to the first arrival of Euroamericans [approximately 150 BP]). Studies in the western and eastern portions of the Great Basin in the area now included in the state of Nevada indicate that human occupation occurred in the area as early as approximately 12,000 BP. Information for this time period is limited but suggests that the groups were small, very mobile, and may have relied on hunting in an environmental setting that was wetter and cooler than the present climate (Obermayr and Dugas 1996).

The Pre-Archaic lifestyle focused on big game hunting, utilization of smaller animals, and consumption of easily available and easily processed plant materials generally associated with the lacustrine/marsh environment present at the time (Obermayr and Dugas 1996). Pre-Archaic assemblages have been found near Valmy (located approximately 3 miles north of the project area), Rye Patch Reservoir, Susie Creek, and along the Utah-Nevada border at Smith Creek Cave. Isolated finds indicative of the Pre-Archaic tradition also have been found near Carlin (Newsome 1994).

The beginning of the Archaic period coincided with the onset of a warming and drying period in the

region. The period has been subdivided into the Early, Middle and Late phases. The Early Archaic (7,000 to 4,000 BP) is marked by the development of plant processing. Early Archaic period sites tend to be found in valley bottoms near permanent water sources and indicate seasonal occupation. Human presence in the vicinity of the proposed project was probably sparse during this time period (Obermayr and Dugas 1996).

Drier climatic conditions became more apparent in the Middle Archaic (4,000 to 1,200 BP) with resultant increased habitation in optimal areas. During the Middle Archaic, regional human adaptation to the climatic changes included a broadening of exploitation of the resource base and establishment of semi-permanent seasonal habitations within a home range. Consumption of plant foods and smaller animals was increased, groups generally became more mobile in response to seasonal resource dispersion and density, and long term storage of resources was developed. This was evidenced by wider site distribution, greater variability in assemblages, and the appearance of larger and more complex living structures and storage (Obermayr and Dugas 1996). During the Middle Archaic, use of upland settings appears to have increased and sites found in these areas are generally associated with resource procurement activities and forays (hunting, plant gathering and processing and wood gathering) (Skinner 1996; Miller et al. 1996).

The late Archaic (1,200 to 150 BP) was marked by the introduction of the bow and arrow and a continued use of a wide variety of ecozones and food sources. Pottery and horticulture were not developed in the region; instead populations made seasonal rounds relying on a great variety of fauna and flora with the emphasis changing from riverine to desert species. Sites at Rye Patch Reservoir, to the north and west of the project area, indicate that rabbits were highly utilized (Skinner 1996; Miller et al. 1996).

Sites in the vicinity of the project area that contain Archaic components include the Wagon Jack Shelter, Eastgate Cave, James Creek Shelter, the Carlin Basin sites, Danger Cave, Hidden Cave, Deer Creek Cave, South Fork Shelter, and the Triple T Shelter (Newsome 1994). Investigations to the north of the project area near Treaty Hill identified permanent Archaic-period winter camps with surrounding special activity camps for hunting and seed gathering and processing (Clay 1989).

Linguistic evidence suggests that Numic speaking people reached the area sometime between 1,000 to 1,300 AD. These people were the ancestors of the Paiute and Shoshone, who were living in the area at the time of the incursion of Euroamerican trappers, explorers, and settlers into the region (Clay 1989).

**Historic Period.** The first major contact between Euroamericans and the local native populations occurred in 1828, when Peter Skene Ogden, leader of a Hudson's Bay Fur Company trapping party, entered the study area. He trapped beaver just above modern-day Winnemucca and then proceeded downstream on the Humboldt River to the vicinity of Mill City, located north and west of the project area. Ogden made two more expeditions through the area in 1829 and produced a map of the Humboldt Basin. During the second expedition, his group encountered a large band of Native Americans in the area (Skinner 1996). From 1833 to 1834, Joseph Walker explored the Humboldt River area along an east to west route that would become the California National Historic Emigrant Trail (Clay 1989). This expedition was noteworthy for the first recorded armed conflict with the Native Americans of the region. This conflict resulted in the deaths of over 40 Indians. John Fremont explored the area in 1843-44 and again in 1845. The Humboldt River was named by Fremont in honor of geographer Baron Alexander von Humboldt (Harmon et al. 1988a). Expeditions usually left limited site evidence since they were of short duration and involved small groups of individuals.

Settlers bound for Oregon and California followed the trappers and explorers along the Humboldt River, north of the project area, beginning with the Bidwell-Bartleson party in 1841. The California Gold Rush saw over 197,600 emigrants and their livestock using

the California National Historic Emigrant Trail route between 1849 and 1860. In the vicinity of the Proposed Action, the California Trail route crossed south of the Humboldt River near Lone Tree Hill. The trail actually consisted of a series of trails often superimposed on each other. The emigrants often used areas away from the Trail for campsites, water and forage for stock, and to hunt. From the 1850s to 1915, the Stonehouse Station, a stage station, inn, and post office located approximately 6 miles northwest of the project area, provided meals and protection to travelers and emigrants along the Trail.

The presence of emigrant parties on their way to California often resulted in conflicts between the emigrants and the aboriginal groups in the area. The emigrants and their livestock had a significant effect on the Great Basin ecosystem. They depleted the available forage, polluted water, and consumed native food sources. This lead to resentment and privation among the native peoples, often causing them to attack emigrant parties. This furthered resentment and hostilities between the two groups (Harmon et al. 1988a; Skinner 1996; Miller et al. 1996).

Use of the California National Historic Emigrant Trail route (also known as the Humboldt Trail) decreased in the middle 1870s with the advent of low-fare passage on the transcontinental railroad (Skinner 1996; Miller et al. 1996). Site evidence of the Trail includes campsites, remains of wagons or other materials, remains of animals, gravesites, and trading posts (BLM 1995).

Mining interest began in north-central Nevada in the late 1850s with the discovery of mineral wealth near Dayton and Virginia City, Nevada. The Battle Mountain Mining District, which includes the Marigold Mine, was established in 1866 and remained relatively active until 1885. By 1870, 32 mines, a mill and 2 smelters operated in the District. These operations were generally located on the southeastern slopes of Battle Mountain, south of the project area, although historic mine sites have been located in the Marigold Mine area. The first records for the Marigold Mine were from 1938 and included a mining assessment that lists $600 in improvements to claims in the area, including a few hundred feet of crosscuts, drifts, buildings, and roads (Newson 1994; Obermayr and Dugas 1996).

Some of the early emigrants and miners stayed on in the region as ranchers and farmers. Agricultural settlement patterns were influenced by the distribution of the mines and the arrival of the railroad. Many of the early small farms supported the local mines. During the 1870s and 1880s, cattle ranching became a important economic factor along the Humboldt River and in the project region. Severe winters in 1889 and 1890 devastated the cattle industry and lead the remaining ranchers to reduce the size of their herds and begin feeding cattle during the winter. To produce hay for feed, irrigation systems were developed in the valleys. Sheep ranching increased during the 1890s to 1920s, since sheep were better able to withstand the harsh conditions. Ranching and farming remains include trash scatters from sheep camps, irrigation ditches, corrals, watering troughs, and fencelines (BLM 1995).

Mining resurfaced in the project vicinity in the early twentieth century with an emphasis on silver and copper, and the Battle Mountain Mining District boomed again.

## Cultural Resources Identified in the Project Area

Maps 3-17 and 3-18 illustrate the Area of Potential Effect (APE) and the cumulative assessment area for cultural resources under the Proposed Action. The APE is defined as the area within the proposed permit boundary and generally includes a checkerboard of Federal and private lands that the proposed project mine would expand onto. The cumulative assessment area is bounded by I-80 and the county line. Maps 3-17 and 3-18 also depict the location of 12 cultural resource inventories that have occurred in areas associated with the APE or areas that lie outside but within 500 feet of the APE. Summaries of surveys conducted and sites identified are presented in Table 3-28, and Tables E-1 and E-2 in Appendix E. These inventories, which detail the results of intensive

archaeological evaluations conducted within the area of this proposed project, are on file at the BLM offices in Winnemucca or Battle Mountain, Nevada. Only brief summaries and general location descriptions have been provided in the EIS to protect the confidentiality of the sites. Discussions concerning sites adjacent to the APE are included here because of the potential for the Proposed Action to create indirect effects on these sites.

The first cultural resources inventory identified as being conducted in the vicinity of the APE was a 1974 survey along a proposed Sierra Pacific Power Company 230-kV transmission line right-of-way. The inventory, outlined in BLM cultural resources (CR) report CR2-83, preformed by Rusco and Seelinger (1974) did not identify any sites within the APE. A second survey of material test areas was conducted in the project area by the Nevada Department of Highways in 1977 (BLM CR Report CR2-248). No sites were identified within or adjacent to the APE during this survey.

A Class III cultural resource inventory of the Marigold Mine complex was conducted by Basin Research Associates, Inc., in March of 1988 on behalf of Delta Environmental Consultants (BLM CR Report CR2-2236) (Harmon et al. 1988a). The inventory covered approximately 1,760 acres and resulted in the location and recordation of six cultural properties. Two of the properties were identified as prehistoric isolated finds. Three of the properties are small prehistoric sites (Cr-NV-22-4244, -4245, -4246) containing modified and unmodified chalcedony and basalt flakes. The sixth property located by the inventory represents the historic central area of the original Marigold Mine (Cr-NV-22-4247), which includes numerous roads, bore holes, shafts, construction and geological debris, and domestic refuse. The three small prehistoric sites and the historic Marigold Mine site are located within the APE. None of the cultural properties located by this inventory are eligible for inclusion in the NRHP with SHPO concurrence (Becker 1988).

In May and June of 1988, Basin Research Associates, Inc., conducted a supplemental Class III cultural resource inventory of an additional 2,000 acres of public and private land within the boundaries of the original Marigold Mine area (BLM CR Report CR2-2236 [Addendum]) (Harmon et al. 1988b). The supplemental inventory, conducted on behalf of Glamis Marigold Mining Company, resulted in the location and recordation of five additional cultural properties. Four of the properties were isolated finds. The remaining property is a small prehistoric site (Cr-NV-22-4362) containing lithic materials. Site Cr-NV-22-4362 is located within the APE and is not eligible for inclusion in the NRHP with SHPO concurrence (Becker 1988).

Personnel from Archaeological Research Services, Inc. conducted a Class III cultural resource inventory in April 1989 as part of the Trout Creek Project on behalf of Hecla Mining Company (BLM CR Report CR2-2294) (Clay 1989). During the inventory of approximately 1,280 acres, ARS recorded 30 previously unrecorded prehistoric properties. Twenty–three of the properties are small sites or isolated finds, and the other seven sites are large lithic scatters. Five of the lithic scatter sites contain less than 75 items, no temporally diagnostic artifacts, no obvious depth or features, and no distinctive spatial patterning. The other two large sites are a seasonal camp and a silicified siltstone quarry area. Of these 30 sites, none are located in the APE and two are located within 500 feet of the APE (Cr-NV-22-4698, -4699). None of the sites are recommended by the BLM as eligible for inclusion in the NRHP; the SHPO has concurred with these recommendations (James 1989).

Frank Johnson with Environmental Management Associates conducted a Class III archaeological inventory of approximately 835 acres in the vicinity of the Proposed Action in July and August of 1990 (BLM CR Report CR2-2384). The survey included inventory of a proposed waste dump and leach pad area, exploration pits, and a proposed haul road, access road and a utility right-of-way. The inventory identified nine previously unrecorded properties. None of the

LEGEND

PRIVATE LAND/PUBLIC LAND CLAIM BOUNDARY

CURRENT PERMIT BOUNDARY

PROPOSED PERMIT BOUNDARY (AREA OF POTENTIAL EFFECT)

EXISTING FACILITIES

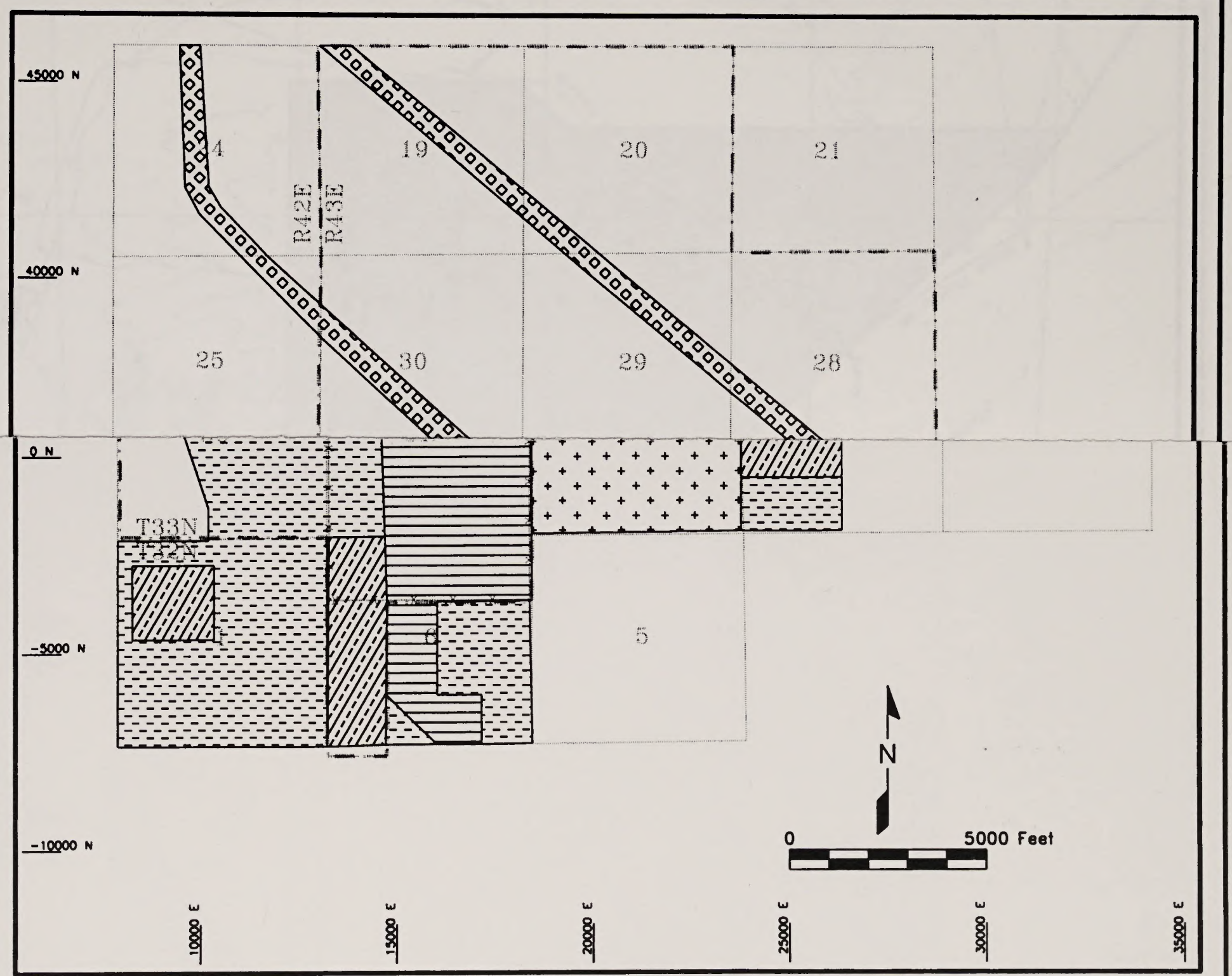
PROPOSED MINE OPERATIONS

LAND STATUS

Rusco and Seelinger 1974 (CR2-83)

Wallof and Cunningham 1977 (CR2-248)

Harmon et al. 1988 (CR2-2236)




Marigold Mine

Map 3-17

Cultural Resource Inventories in the Area of Potential Effect

archaeological evaluations conducted within the area of this proposed project, are on file at the BLM offices in Winnemucca or Battle Mountain, Nevada. Only brief summaries and general location descriptions have been provided in the EIS to protect the confidentiality of the sites. Discussions concerning sites adjacent to the APE are included here because of the potential for the Proposed Action to create indirect effects on these sites.

The first cultural resources inventory identified as being conducted in the vicinity of the APE was a 1974 survey along a proposed Sierra Pacific Power Company 230-kV transmission line right-of-way. The inventory, outlined in BLM cultural resources (CR) report CR2-83, preformed by Rusco and Seelinger (1974) did not identify any sites within the APE. A second survey of material test areas was conducted in the project area by the Nevada Department of Highways in 1977 (BLM CR Report CR2-248). No sites were identified within or adjacent to the APE during this survey.

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Personnel from Archaeological Research Services, Inc. conducted a Class III cultural resource inventory in April 1989 as part of the Trout Creek Project on behalf of Hecla Mining Company (BLM CR Report CR2-2294) (Clay 1989). During the inventory of approximately 1,280 acres, ARS recorded 30 previously unrecorded prehistoric properties. Twenty–three of the properties are small sites or isolated finds, and the other seven sites are large lithic scatters. Five of the lithic scatter sites contain less than 75 items, no temporally diagnostic artifacts, no obvious depth or features, and no distinctive spatial patterning. The other two large sites are a seasonal camp and a silicified siltstone quarry area. Of these 30 sites, none are located in the APE and two are located within 500 feet of the APE (Cr-NV-22-4698, -4699). None of the sites are recommended by the BLM as eligible for inclusion in the NRHP; the SHPO has concurred with these recommendations (James 1989).

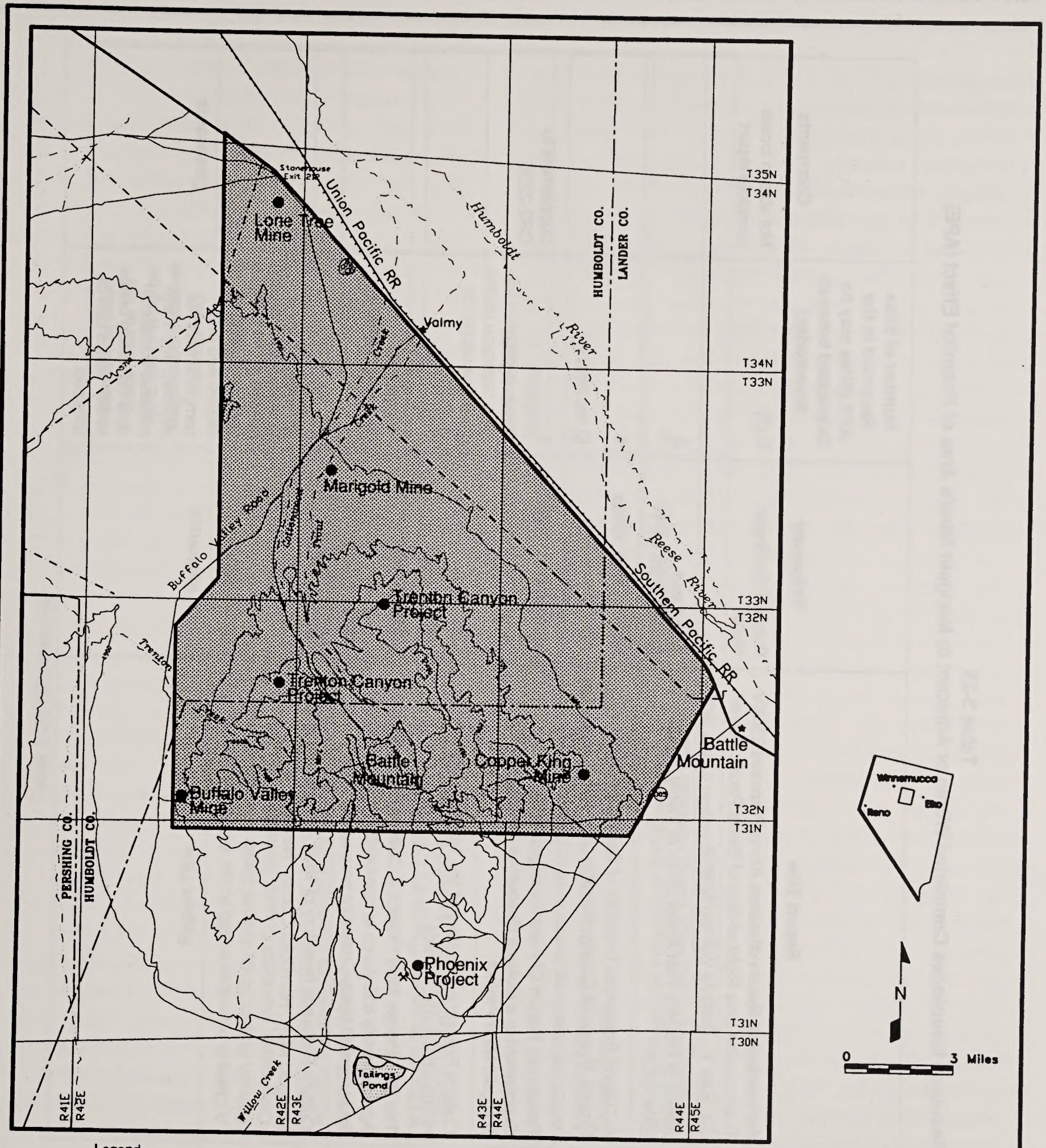
Frank Johnson with Environmental Management Associates conducted a Class III archaeological inventory of approximately 835 acres in the vicinity of the Proposed Action in July and August of 1990 (BLM CR Report CR2-2384). The survey included inventory of a proposed waste dump and leach pad area, exploration pits, and a proposed haul road, access road and a utility right-of-way. The inventory identified nine previously unrecorded properties. None of the

Marigold Mine

Map 3-17

Cultural Resource Inventories in the Area of Potential Effect






Legend

River or Intermittent Drainage

Powerline

Cumulative Effects Area for Cultural Resources

Source for Base Map: BLM, 1998

Marigold Mine

Map 3-18

Cumulative Assessment Area for Cultural Resources

**Table 3-28**
**Cultural Resource Inventories Completed Within or Adjacent to Marigold Mine's Area of Potential Effect (APE)**

| BLM Report Number | Report Title | Reference | Number of Sites Recorded in the APE (Sites may be Duplicated between Inventories) | Comments |
|---|---|---|---|---|
| CR2-83 | Archaeological Reconnaissance Along Proposed 230KV Transmission Line Right-of-Way of Sierra Pacific Power Co. Part 1. Tracy to Valmy, Nevada | Rusco & Seelinger 1974 | 0 (?) | Not able to locate complete report |
| CR2-248 | Survey of Material Test Areas South of Valmy, Nevada EA #70820 | Wallof and Cunningham 1977 | 0 | |
| CR2-2236 | A Cultural Resources Inventory of the Marigold Mine Project, Humboldt County, Nevada | Harmon et al. 1988a | 4<br>(0 are eligible) | |
| CR2-2236 (Addendum) | Preliminary Report Of Field Investigations for a Supplement to a Cultural Resources Inventory of the Marigold Mine Project | Harmon et al. 1988b | 1<br>(0 are eligible) | Supplement to CR2-2236 |
| CR2-2294 | Cultural Resource Inventory of the Trout Creek Project, Humboldt County, Nevada | Clay 1989 | 0 | |
| CR2-2384 | The Stonehouse Mine Project: A Cultural Inventory of Approximately 835 Acres in Humboldt County, Nevada for Marigold Mining Company | Johnson 1990 | 0 | |
| CR2-2612 | Cultural Resource Inventory of 1880 Acres South of the Marigold Mine, Humboldt County, Nevada | Newsome 1994 | 10<br>(1 is eligible; 7 are not eligible; 1 site has one component as eligible and one component as not eligible); and 1 site requires additional data collection before NRHP status can be finalized | |

**Table 3-28 (Continued)**

| BLM Report Number | Report Title | Reference | Number of Sites Recorded in the APE (Sites may be Duplicated between Inventories) | Comments |
|---|---|---|---|---|
| CR2-2681 | A Class III Inventory of 685 Acres Within the Trenton Canyon Project Study Area of Santa Fe Pacific Gold Corporation, Humboldt County, Nevada | Dugas 1995 | 2<br>(1 is eligible, 1 is not eligible) | |
| CR2-2632 | A Cultural Resources Inventory in the Trenton Canyon Area, Humboldt and Lander Counties, Nevada | Obermayr & Dugas 1995 | 12<br>(4 are eligible, 8 are not eligible) | |
| CR2-2686 | A Class III Inventory of Section 21, T33N, R43E for the Trenton Canyon Project, Humboldt County, Nevada | Dugas 1996 | 1<br>(requires additional data collection before NRHP status can be finalized) | |
| CR2-1256 | A Cultural Resource Inventory of 187 Acres for the Marigold Mine Rock Dump Project near Valmy, Humboldt County, Nevada | Crosland & Prince-Mahoney<br>1996 | 0 | |
| CR2-1316 | A Cultural Resource Inventory of 690 Acres for the Marigold Mine Project Near Valmy, Humboldt County, Nevada. (This report has not been reviewed by the BLM) | Martin-Moore 1997 | 0 | |

properties were located in the proposed APE and none of the properties were eligible to the NRHP with SHPO concurrence (James 1990). A Class III cultural resources inventory of 1,880 acres south of the Marigold Mine was conducted by P-III Associates (BLM CR Report CR2-2612) (Newsome 1994) for a proposed expansion of the Marigold Mine Project onto private land and land administered by the BLM. As a result of the inventory, 14 cultural resource sites were identified. These included five prehistoric sites, six historic sites and three sites with both historic and prehistoric components. Ten of the 14 cultural resource sites recorded are located within the APE boundary (Cr-NV-22-6085, -6086, -6087, -6088, -6089, -6090, -6091, -6092, -6093, -6094). Of these ten sites, Cr-NV-22-6085, -6086, and -6091 are prehistoric lithic scatters containing numerous chert and obsidian tool fragments, and Cr-NV-22-6087, -6088, -6089, -6092, and -6093 are historic trash scatters containing jars, glass fragments, cans, and tobacco tins. The remaining two sites (Cr-NV-22-6090 and 6094) contain both prehistoric lithic and historic trash scatter. The prehistoric component of Site Cr-NV-22-6094 was identified as eligible for inclusion in the NRHP under Criterion d by the BLM. The SHPO concurred that the historic component was eligible to the NRHP (see Appendix ***F*** for a discussion on cultural site eligibility criteria) (Baldrica 1994). The remaining sites within the APE boundary, as well as the historic component of site Cr-NV-22-6094, were originally recommended by the BLM as not eligible for inclusion in the NRHP. The SHPO concurred with all of the recommendations with the exception of site Cr-NV-6090; final determination is pending on further archaeological investigation of the site (Baldrica 1994). In 1995, reevaluation of Site Cr-NV-22-6085 by Obermayr and Dugas (1995) (BLM CR Report CR2-2632[P]) resulted in a new recommendation by the BLM of eligibility to the NRHP. In 1996, the SHPO concurred with the new recommendation and the site is now eligible to the Register (Baldrica 1996a).

In September and November 1994 and April, June, and July of 1995, Intermountain Research conducted a cultural resource inventory (BLM CR Report CR2-2632[P]) in the Trenton Canyon area (Obermayr and Dugas 1995, revised 1996). This Class III survey encompassed approximately 10,221 acres in both Humboldt and Lander Counties. The inventory also included approximately 13.0 miles of potential pipeline, power line, and access road corridors extending from the Trenton Canyon Mine area to the Lone Tree Mine. The inventory identified eight prehistoric lithic scatter sites (previously identified sites Cr-NV-6085, -6086; newly identified sites Cr-NV-6199, -6204, -6205, -6235, -6239, -6240), and four historic sites (previously identified Cr-NV-6088 and -6089; newly identified Cr-NV-6251and -6252) located within the APE boundary. Sites Cr-NV-22-6085, -6199, -6204, and -6205 are eligible for inclusion on the NRHP with SHPO concurrence (Baldrica 1996a). The SHPO concurred with the BLM's determination that sites Cr-NV-22-6086, 6235, 6239, and 6240 are not eligible for inclusion to the NRHP (Baldrica 1996a). Historic sites Cr-NV-22-6088, 6089, 6251, and 6252 consist of trash debris, and were recommended as ineligible for inclusion to the NRHP with concurrence from the SHPO (Baldrica 1996a). The survey identified six sites located within 500 feet of the APE. These included Cr-NV-22-6195, -6196, -6242, -6246, –6247, and –6248. Sites Cr-NV-22-6195, -6246, -6247, and –6248 have been determined eligible to the NRHP with SHPO concurrence (Baldrica 1996a). Sites Cr-NV-22-6196 and –6242 are ineligible to the NRHP with SHPO concurrence (Baldrica 1996a).

As part of the Trenton Canyon Mine Project, Class II and Class III archaeological surveys were conducted by Intermountain Research in October 1995 on 685 acres of public and private lands distributed among nine parcels located on the northwestern and western slopes of Battle Mountain (BLM Report CR2-2681[P]) (Dugas 1995). Under the Class II survey, approximately 56 acres of 40 percent slopes or greater were surveyed using transects approximately 300 feet apart. The remaining acreage was surveyed to Class III standards using transects approximately 90 feet apart. The inventory discovered six previously unrecorded prehistoric archaeological sites. Six previously recorded sites adjacent to the surveyed parcels were also relocated. Two of the 12 sites

identified, Cr-NV-6263 and –6085, are located within the APE boundary. Cr-NV-6263 is a sparse scatter of historic and modern debris adjacent to Trout Creek. This site was recommended by the BLM as not eligible for inclusion in the NRHP with SHPO concurrence (Baldrica 1996). Previously recorded Site Cr-NV-6085, a sparse and diffuse scatter of lithic material, was originally identified and recommended as not eligible to the NRHP by Newsome (1994) with SHPO concurrence (Baldrica 1994). Based upon additional information collected during the 1995 inventory by Obermayr and Dugas (1995), the SHPO determined that site Cr-NV-6085 is eligible for inclusion in the NRHP under Criterion "d" and that the site should be protected due to its location within 100 feet of the Trenton Canyon Project (Baldrica 1996b). One site, Cr-NV-22-6264, is located within 500 feet of the APE boundary. This site is eligible to the NRHP with SHPO concurrence (Baldrica 1996b).

On behalf of the Trenton Canyon Project, a Class III archaeological survey was conducted in December 1995 by Intermountain Research on approximately 680 acres of private land located on the northern slopes of Battle Mountain (BLM Report CR2-2686[P]) (Dugas 1996). The inventory discovered four previously unrecorded prehistoric archaeological sites. One previously recorded site (Cr-NV-22-6090), adjacent to the survey parcel, was revisited. Of the located sites, Sites Cr-NV-22-6090 is the only site located within the APE boundary. Three sites, Cr-NV-6375, -6376 and –6377 are located within 500 feet of the APE boundary. Cr-NV-22-6090 was previously recommended by the BLM as not eligible for inclusion to the NRHP (Baldrica 1994) and that recommendation was repeated as part of this inventory; SHPO concurrence is pending. The prehistoric component of Cr-NV-22-6376 was recommended as eligible for inclusion to the NRHP with concurrence from the SHPO (Baldrica 1996c). Sites Cr-NV-22-6375 and -6377 were found ineligible to the NRHP with SHPO concurrence (Baldrica 1996c).

In April 1996, JBR completed a Class III inventory of a 187-acre parcel proposed for a rock dump at the Marigold Mine (BLM CR-1256CN). No sites were identified during this survey (Crosland and Prince-Mahoney 1996).

In July and August 1997, JBR conducted a Class III inventory of five parcels totaling 690 acres for Marigold Mine (BLM CR2-1316). No sites were identified for this survey (Martin-Moore 1997).

In summary, five NRHP-eligible sites (Cr-NV-22-6085, -6094, -6199, -6204, -6205) and one unevaluated site (CrNV-22-6090) have been identified as lying within the APE. Site Cr-NV-22-6090 has been determined ineligible to the NRHP by the BLM; final determination is pending from the SHPO. Six NRHP-eligible or unevaluated sites (Cr-NV-22-6376, -6246, -6264, -6195, -6247, -6248) have been identified as lying within 500 feet of the APE.

### 3.14.1.2 Ethnography and Native American Consultation

The ethnographic background for the APE is generally the same for the area of cumulative effect. The issues and information identified below include data from literature and discussions with Western Shoshone and Paiute groups (Battle Mountain Band Council, the Duck Valley Shoshone-Paiute Business Council, the Te-Moak Tribe, the Fort McDermitt Tribal Council, and the Winnemucca Colony Tribal Council).

**Setting**

The project area is located near the traditional boundary between the Northern Pauite and the Western Shoshone, which is generally considered to be at Iron Point about 20 miles north-northwest of the project area (Newsome 1994). The project area lies in the region of the Makuhadokado or Pauida tuviwarai/Pauide tuviwarai Pauites and the White Knife or Tosawihi group of the Western Shoshone (Newsome 1994). The Tosawihi appear to have been the predominant group utilizing resources in the project area. The White Knife Shoshone are named for the white chert tool stone found at the Tosawihi

Quarries located about 40 miles northeast of the project area. The White Knives wintered around Battle Mountain and generally inhabited the area bordering Rock Creek. The Western Shoshone and Northern Pauite interacted in the boundary area, intermarrying to some extent and conducting some cooperative hunts, although hostilities between the two groups were reported, generally related to "woman stealing" (Clay 1989; Newsome 1994).

These groups maintained a semi-nomadic lifestyle that corresponded to the availability of floral and faunal subsistence resources on a seasonal basis and involved seasonal movement between different vegetation zones and exploitation of a wide variety of food resources. Hunting of large and small game, including antelope, rabbit, waterfowl and rodents; fishing using nets, harpoons, and weirs; and gathering of grass seed, roots, berries, and pine nuts provided subsistence (Mires and Kautz 1993). The size and structure of the groups fluctuated in response to the availability and abundance of food resources. During winter, extended family groups gathered near caches of piñon nuts that had been gathered during the fall. Movement in winter was minimized and camps were maintained in areas with plentiful food resources, commonly along rivers, or near cached supplies of nuts, seeds, dried meat or other foods. Groups of Western Shoshone wintered on the Humboldt River, both above and below the project area (Obermayr and Dugas 1996). Wintering camps located near the project area included one at Tonomudza (Greasewood Point) near Battle Mountain, one at Bohowia (Sagebrush Pass) near Iron Point, and one at Pagowe near Stonehouse. Pagawi also was identified as a center for rabbit drives. This location is found approximately 7 miles north of the project area (Harmon et al. 1988a). The groups separated into nuclear families in the spring and foraged until fall when they gathered together in camp groups to perform communal hunts and gather pine nuts (Newsome 1994).

In the late 1800s the Duck Valley Reservation in northern Nevada was established and many Western Shoshone relocated there over the years. Small parcels of Federal lands were also set aside in 1900 as "Indian colonies" in areas such as Elko and Battle Mountain (Obermayr and Dugas 1996).

**Native American Consultation**

This section summarizes the process to gather information from Native Americans potentially affected by the proposed expansion of the Marigold Mine. A complete report (*Marigold Mine Native American Consultation Summary Report* [ENSR 1999]) detailing the information gathering process has been prepared and is available at the BLM office in Winnemucca, Nevada. Copies of the summary report also have been provided to representatives of the Native American groups interviewed during the process.

The process was conducted to comply with Federal and state laws that apply to resources with traditional and/or religious significance to Native Americans. The following laws either provide resource protection and/or require Native American consultation: the National Environmental Policy Act, Federal Land Policy and Management Act of 1976, American Indian Religious Freedom Act, Religious Freedom Restoration Act, Archaeological Resources Protection Act, Native American Graves Protection and Repatriation Act of 1990 (PL 101-601), Nevada Indian Burial Protection legislation, and National Historic Preservation Act of 1966, (PL-89-665, as amended). Under the National Historic Preservation Act, Federal undertakings must be assessed to determine if historic properties, traditional cultural places, or use areas will be affected by a proposed undertaking.

Consultation was initiated with notification letters outlining the proposed mine expansion. Notification letters and requests for comments were sent by the BLM in March 1999 to the Battle Mountain Band Council of the Te-Moak Tribe of Western Shoshone, Duck Valley Shoshone – Paiute Business Council, Te-Moak Tribe of Western Shoshone, Fort McDermitt Tribal Council, and Winnemucca Colony Tribal Council. These tribal groups were identified as having affiliations with the proposed project area. No

previously identified traditional use or religious sites used by these groups were located within the proposed project area during literature searches conducted at the Battle Mountain and Winnemucca BLM offices by the BLM's cultural resources contractor.

The notification letters summarized the proposed action and requested input from the tribal groups. Following issuance of these letters, an informational meeting concerning the proposed action was requested by and arranged with the Battle Mountain Band. No additional comments related to the notification letters have been received as of the date of this report.

BLM and GMMC presented an informational meeting to the Battle Mountain Band on the proposed action on May 27, 1999, in Battle Mountain, Nevada. Attendees included Les Boni and Regina Smith (BLM); Gary Back (EMA); Henry Reed and Karen Jury (GMMC); Battle Mountain Band Council members Lydia Johnson, Clarence Andreozzi, Paul Snooks, and Daniel Raymond; Band Environmental Coordinator Bernice Lalo; and Battle Mountain Band member Ed Holley.

Concerns identified during the meeting included questions regarding: reclamation activities that would be conducted; whether reclamation would include reintroduction of native plants and wildlife; control of noxious weeds and non-native species; the potential for pit lakes; subsurface water pumping and subsidence related to the pumping; air quality; cumulative effects related to water pumping; employment of Native Americans at the mine; transportation of hazardous materials; and emergency response plans. Specific comments are discussed in Section 3.14.2.1 of this EIS. A request for information on and access to archaeological studies related to the project was made by Bernice Lalo during the meeting. After the meeting, BLM provided the Battle Mountain Band Council with a copy of a prototype agreement to share confidential information on cultural resources with Native Americans; no response resulted from this letter.

During the meeting, a request for a mine tour was made. The Marigold Mine tour was held on July 28, 1999. Henry Reed, the environmental coordinator with GMMC, led the tour. Les Boni and Regina Smith with the Winnemucca BLM office also attended, along with Polly Quick (project ethnographer), Bernice Lalo (Battle Mountain Band environmental coordinator), and her assistant, Lester Decker; Chris Sewell (Western Shoshone Defense Project, Crescent Valley who attended at the request of Carrie Dann); Erickson Hooper of the Duck Valley Shoshone-Paiute Tribe; and Battle Mountain Band members Florine Maine, Delbert Holley, and Evangeline Holley.

Concerns identified during the tour included: revegetation; loss of springs; loss of cultural sites; disturbance to the earth and the religious significance of the land; effects to vegetation, wildlife, and air quality; the possibility that there were toxic sediments created by the mine; and review of archeological site information. Detailed descriptions of issues identified during the mine tour are provided in Section 3.14.2.1 of this EIS. No cultural sites, traditional use areas, or other sites of special significance to Native Americans were identified during the mine tour. However, according to Florine Maine, Battle Mountain peoples historically traveled through the mine area and camped at Mud Springs on their way to pinenut collecting areas.

After the meetings and tour, BLM requested and was placed on the Battle Mountain Band Council agenda; however, before that date, a meeting was requested by the Battle Mountain Band Council to review the material prior to taking it to the community. The BLM sent follow-up letters making a final request for meetings, comments and/or input in September and October 1999 to the Battle Mountain Band Council.

Follow-up telephone contacts were made throughout the process by the BLM and an ethnography contractor to identify tribal governments and individuals that wanted more information and to set up meetings and a tour of the mine site. ***No comments were received during these***

***conversations. However,*** individuals ***did*** provide comments during the meeting and tour.

### 3.14.1.3 Paleontology

Paleontological resources or fossils are the physical remains, impressions, or traces of plants or animals from past geologic ages. Paleontological resources are important mainly for their potential to provide scientific dating information, information on the evolutionary history of plants and animals, and information on paleoenvironments and paleoclimates. The significance or sensitivity of a fossil resource is subjective and based generally upon the type of fossil material, its uniqueness, and its association with other fossil resources. Vertebrate fossils are generally considered to be the most significant; however, occurrences of invertebrates, plants, and other diagnostic fossils also can provide valuable information.

The BLM is mandated by the following Federal regulations to evaluate paleontological sensitivity on lands being considered for project approval:

- The Historic Sites Act of 1935 (P.L. 74-292; 49 Stat. 666, 16 U.S.C. 461 et seq.);
- NEPA (P.L. 91-190; 31 Stat. 852, 42 U.S.C. 4321-4327); and
- The Federal Land Policy and Management Act of 1976 (P.L. 94-579; 90 Stat. 2743, U.S.C. 1701-1782).

The BLM also has recently released a *draft* Paleontology Program Manual and Handbook (March 11, 1998), which establishes a classification system for ranking paleontological areas for potential for noteworthy occurrences of fossils.

In summary, the BLM handbook states that public lands may be classified based on their likelihood to contain fossils, using the following criteria:

- *Condition 1* - Areas that are known to contain fossil localities. Consideration of paleontological resources will be necessary if available information indicates that fossils are present in the area.
- *Condition 2* - Areas with exposures of geological units or settings that are likely to contain fossils. The presence of geologic units from which fossils have been recovered elsewhere will require an assessment of these same units if they occur in the area of consideration.
- *Condition 3* - Areas that are very unlikely to produce fossils based on their surficial geology, e.g., igneous or metamorphic rocks, extremely young alluvium, colluvium, or aeolian deposits.

In keeping with the historical policies adopted by the Department of the Interior and the BLM, these classification guidelines apply primarily to vertebrate fossils. However, the BLM indicates that where noteworthy occurrences of invertebrate or plant fossils are known or expected, the same procedures should be followed.

Review of paleontologic literature and BLM maps in the Winnemucca Field Office, which locate areas of potential and significant paleontological importance, indicated that the project area lies in Condition 2 and Condition 3 areas. Although fossils have been found in the project vicinity, no established fossil-collecting localities or significant deposits have been previously identified in the project area.

A classification system similar to that used by the BLM was proposed by the Society of Vertebrate Paleontology in 1995 for use in defining the paleontological sensitivity of geological formations. This system includes the following paleontological categories:

**High Potential**. Rock units from which vertebrate or significant invertebrate fossils or significant suites of plant fossils have been recovered are considered to have a high potential for containing significant non-

renewable fossiliferous resources. These units include, but are not limited to, sedimentary formations and some volcanic formations, which contain significant nonrenewable paleontologic resources anywhere within their geographic extent, and sedimentary rock units temporally or lithologically suitable for the preservation of fossils.

**Undetermined Potential.** Specific areas underlain by sedimentary rock units for which little information is available are considered to have undetermined fossiliferous potential. Field surveys by a qualified vertebrate paleontologist to specifically determine the potentials of the rock units are required before programs of impact mitigation for such areas may be developed.

**Low Potential**. Reports in the paleontological literature or field surveys by a qualified vertebrate paleontologist may allow determination that some areas or units have low potentials for yielding significant fossils. These deposits generally will not require protection or salvage operations.

Using this classification system and the BLM's system, the major sequences of rocks in the project area, which are Paleozoic marine sedimentary rocks, were evaluated for paleontological potential (see Section 3.2.1, Geology, for a description of the general geology of the area). The major potential fossil-bearing lithostratigraphic units that outcrop in the immediate project area include the Valmy Formation, the Pumpernickel Formation (which is often combined with the Havallah), the Havallah Formation, the Antler Peak Limestone and Battle Formations, Quaternary Gravels, and alluvial deposits. Several other formations, including the Harmony and Edna Formations, do not outcrop in the project area but are present at depth. A description of the geologic formations in the project area is provided in Section 3.2, Geology and Minerals.

The Valmy Formation is Ordovician and contains a large percentage of marine clastic rocks (quartzite, chert) and volcanic materials (greenstone) suggesting that the environment of deposition may have been in or near a volcanic archipelago (Roberts 1964). Interfingerings of limestone lenses found in the formation often contain invertebrate fossils, including trilobites and graptolites (BLM 1997). The study of graptolites (extinct colonial marine organisms), that were collected immediately south of the project area indicate an Early and Middle Ordovician age for the formation (BLM 1997; Roberts 1964; Willden 1964). Various species of graptolites, including Didymograptus, Climacograptus, Glyptograptus, Orthograptus, and Dicellograptus, have been recorded in the Valmy Formation immediately adjacent to the study area (Roberts 1964). Graptolites, which are abundant and not considered a significant resource, are often used as a diagnostic tool in biostratigraphic analysis (correlating the ages of rock units using fossils). This formation is identified as having a low potential for yielding significant fossil deposits.

The Pumpernickel Formation consists of shale, chert, and greenstone with some limestone, sandstone, and pebbly congolomerate. Radiolaria, sponge spicules, and fossilized invertebrate tracks produced by helminthoidal worms, gastropods, and crustaceans have been found in the chert present in the formation (Roberts 1964). Pennsylvanian conodonts, small tooth-like remains of marine organisms, have been found in the Pumpernickel Formation at Battle Mountain (BLM 1997). Conodonts also are used extensively in biostratigraphic analysis. They, however, are also abundant and are not considered to be a significant paleontological resource. Fusulinids fossils also have been found in the formation. These microscopic planktonic foraminifera resemble grains of wheat and also place the age of the Formation sometime in the Pennsylvanian (BLM 1997; Roberts 1964). This formation is also considered to have a low potential for yielding significant fossil deposits.

The Jory Member of the Havallah Formation is located within the project area. This unit, which is the lower member of the formation, is composed of sandstone and interbedded minor amounts of conglomerate, shale, and chert. Middle Pennsylvanian to Early Permian fusuliniids were

found in the Havallah Formation immediately northwest of the proposed mine area (Roberts 1964). Occurrences of crinoid fragments in outcrops of the Havallah Formation have also been identified in the area (BLM 1995). These fossils are not considered to be significant and the paleontological significance for this formation is low.

The Antler Peak Limestone and the Battle Formation are generally Middle to Late Pennsylvanian in age and are included in the Antler Sequence. The Antler Peak Limestone consists of thick extensive limestone units. The Battle Formation is composed mainly of conglomerates and sandstone with thin limestone beds (Roberts 1964). Limestone beds found in the Antler Sequence are well-sorted and contain well-rounded quartz grains, indicating deposition in a moderately high energy near shore environment that would not be conducive for large shell concentrations or mobile invertebrates (JBR 1998). Brachiopods, conodonts, stromatoporoids (primitive sponge-like colonial organisms), corals, syringoporoids, chonetids, and fusulinids have been found in the Antler Peak Limestone in other localities. Fusulinids, stromatoporoids, and other primitive faunal species such as Gondolella, Streptognathodus, Icriodus, Triticites, an unidentified Hydrozoan, and Bradyina have been identified in the Battle Formation (Roberts 1964). Corals of Pennsylvanian to Permian age have been identified in the Antler Sequence near the Marigold Mine (BLM 1995). All of these fossils have been found within this unit in other localities approximately 5 to 6 miles south of the project area and are generally common (Roberts 1964; JBR 1998). Although formations in the Antler Sequence contain proportionally higher numbers and varieties of fossils relative to other formations in the area, these fossils are generally common and the paleontological significance for this formation is considered to be low.

Quaternary Older and Younger Alluvium deposits within the project area generally consist of gravels in a sandy and clayey matrix. Older Alluvium deposits appear to have been deposited through a series of mudflows. Younger Alluvium was formed during dissection of alluvial fans in the Quaternary period and may contain stream, dune, and lake deposits. Vertebrate fossils have been found within loosely consolidated sand and silt associated with Quaternary Lake Lahontan alluvium near Rye Patch Reservoir, approximately 30 to 40 miles west of the project area (BLM 1997). No vertebrate fossils have been identified within the proposed mine permit boundary in Quaternary Alluvium deposits; however, fragments of Quaternary vertebrate fossils from either a horse or camel were collected in alluvium in Section 30, south of Marigold Mine's existing permit boundary and west of the Valmy Deposit (BLM 1995; BLM 1998). The erosional and depositional nature of the alluvial deposits makes it difficult to predict the potential for fossil occurrences. Any fossils that may be located within the alluvium could have been transported long distances from their original depositional area. The paleontological significance for these units would be considered low to undetermined.

## 3.14.2 Environmental Consequences

### 3.14.2.1 Proposed Action

**Cultural Resources**

Discussions of project impacts are limited to sites within the APE deemed to be significant or eligible for inclusion on the NRHP or sites that have Federal and/or state protection under other statutes. In order to be considered eligible for the NRHP, a cultural resource must be a district, site, building, structure, or object that retains its integrity of location, design, setting, materials, workmanship, feeling, and association, and satisfies at least one of the four significance criteria defined in 36 CFR part 60.4. (Appendix ***F*** - Cultural Resources Significance Criteria). Reports detailing the results of intensive archaeological evaluations in the mine area are on file at the BLM offices in Winnemucca and Battle Mountain, Nevada. Only brief descriptions and general location descriptions are provided in the EIS to protect the confidentiality of the sites.

Five eligible sites (Cr-NV-22-6085, -6094, -6199, -6204, -6205) and one unevaluated site (Cr-NV-22-6090) lie within the APE. These six sites could be directly affected by proposed project exploration activities; however, GMMC has agreed to avoid these sites during its exploration activities (see Section 2.2.18.7, Cultural and Paleontological Environmental Protection Measures). Avoidance of the sites should reduce or eliminate any potential effects to known sites that may occur as a result of the Proposed Action.

Cultural resource surveys have not been completed in several portions of the APE, including the southern half of Section 6, the northwest quarter of Section 7, the southeast corners of Sections 9 ***and 16***, and portions of the western one-third of Sections 18, 19, and 30 in Township 33 North, Range 43 East. Modifications to the access road in Section 6 are planned as part of the proposed project and exploration could occur in Section 30. Construction of a drainage diversion is planned adjacent to the unsurveyed portion of Section 9. ***Fencing could occur in Sections 6, 7, 9, 16, 18, 19, and 30.*** Since cultural surveys have not been completed in these areas, it is not clear whether significant sites could be affected by the proposed activities in these areas. Cultural surveys would be required in previously unsurveyed portions of Sections ***6, 7, 9, 16, 18, 19, and 30*** prior to any ground disturbing activities to determine if significant cultural sites could be impacted in these locations.

Indirect impacts to eligible sites Cr-NV-22-6204 and -6205 located within the APE could occur during ground-disturbing activities associated with realignment and operation of the access road. The sites could be more susceptible to vandalism and casual collecting. Changes in topography due to road construction also could result in indirect impacts to cultural resources due to alteration of the amount or patterns of erosion. Improvements in access in the area, particularly in the vicinity of the access road and proposed exploration areas could indirectly impact sites Cr-NV-22-6235, -6246, -6247, and -6248 located outside of the APE.

Indirect impacts to sites would be reduced by implementing the environmental protection measures identified in Chapter 2.0. These measures would include employee education programs, avoidance of known sites, boundary marking, and erosion control measures and reclamation on access and exploration roads. The employee education program would inform employees of the value of cultural resources and the penalties associated with violation of antiquities laws. Boundary marking could consist of distinctly marking the mine permit boundary in the vicinity of the eligible sites and restricting equipment use beyond this boundary. Implementation of the erosion control measures in access and exploration roads and reclamation of these roads following project completion would reduce secondary effects to eligible sites from erosion. These measures would reduce, but not completely eliminate the potential for indirect effects from the Proposed Action.

If previously undocumented sites or subsurface components of documented sites are discovered within the project area during construction and operation, GMMC has agreed to halt construction in the area until the site could be analyzed by a professional archaeologist; as outlined in the environmental protection measures identified in Section 2.2.18. If the previously unidentified resources are determined eligible for the NRHP or protected under other state and Federal statues, impacts would be mitigated through an appropriate data recovery program agreed upon by the BLM, the SHPO and, if necessary, the Advisory Council on Historic Preservation.

Prior to initiation of any disturbance on-site, a Section 106 consultation between the BLM and the SHPO must be completed, as required under 36 CFR 800. Section 106 consultation with the Nevada SHPO regarding the project's effect on cultural resources is currently being conducted. The Section 106 process would be completed prior to the approval of the project (36 CFR 800.3c).

**Native American Concerns**

Information gathering efforts as part of the Native American consultation requirements under NHPA and NEPA included notification and follow-up letters, phone calls, an informational meeting, and a mine tour. Tribal organizations contacted included the Battle Mountain Band Council, the Duck Valley Band of Western Shoshone, the Te-Moak Tribe, the Fort McDermitt Band of Western Shoshone, and the Winnemucca Colony.

The following concerns were identified by tribal members during the informational meeting and the mine tour. No written comments have been received. Responses to concerns also are provided below:

1. Tribal representatives were concerned about reclamation seed mixes and the loss of native vegetation. They requested that reclamation seed mixes include native plants and plants that would support wildlife, particularly "rock chucks" or yellow-bellied marmots. Winterfat, or white sage, and blue sage should be included in the seed mix.

   **Response**: Reclamation seed mixes for the mine site have been modified to include native species, including winterfat. See Section 2.2.19 of the EIS (Reclamation).

2. Tribal representatives were concerned about imported and invasive plants at the mine site. They expressed concern that noxious or invasive weeds would outcompete native plants during and after reclamation. They also were concerned that non-native vegetation, such as tamarisk and Russian olive, has not been removed from other areas. Tribal representatives suggested that studies on weedy and non-native species, such as Kochia scoparia and European grasses, should be conducted to determine how invasive they are.

   **Response**: GMMC has committed to controlling noxious and invasive weeds in the mine area, as described in Section 2.19.6 (Weed Control).

3. Tribal members were concerned about the loss of wildlife habitat in the mine area. Florine Maine said that sage grouse and other game are no longer present. Erickson Hooper said that people are afraid to bring game home to eat for fear that it may be contaminated. Tribal members were concerned that existing mine operations have contributed to the abandonment of the historic sage grouse lek near the 8-South Pit and that the current activity has contributed to disuse of the area.

   **Response**: Impacts to wildlife and loss of wildlife habitat related to the Proposed Action are discussed in Section 3.6 of this EIS. The BLM's post-reclamation land use goal for the mine area is to restore the area to native wildlife habitat use and associated plant communities. Procedures for implementing these goals are discussed in Section 2.2.19 (Reclamation).

4. "Rock chucks" or marmots were once found in the vicinity of the mine area in hills near Cottonwood Creek, but they currently are not present at the mine site. Tribal members would like to see rock chucks and vegetation that would support them reintroduced to the mine area following reclamation.

   **Response**: See response to Concern Number 3.

5. Tribal representatives were concerned about odors from the mine operations. They indicated that cyanide from leaching operations at Battle Mountain Gold can be smelled at Argenta Point and that noxious odors emanate from the Lone Tree Mine at night. No mitigation recommendations were identified.

**Response**: Text discussing the potential for odor release from the Marigold Mine expansion has been added to Section 3.3 (Air Quality) of the EIS. Because leach heaps would be drip irrigated, odors should not be a concern with the proposed operations.

6. Tribal representatives indicated that subsidence along Interstate 80 had occurred as a result of groundwater pumping at Lone Tree. They feel that groundwater pumping is adversely affecting the area and are concerned about the potential effects that could occur as a result of groundwater pumping associated with Marigold Mine operations. They also are concerned about water loss and related water rights. Bernice Lalo suggested a cumulative impact study related to groundwater pumping. Tribal representatives requested pumping figures from local mines.

   **Response**: A limited volume of groundwater (approximately 475 gpm) would be pumped by GMMC for use under the proposed action; water used at the mine would come from the Lone Tree Mine operations. Impacts to water rights or to springs or intermittent creeks in the project area are not anticipated. Effects from groundwater pumping are discussed in Section 3.1 of the EIS.

7. Tribal representatives asked about the number of Native American workers at the mine. Tribal representatives also suggested that the mines should hire an environmental/cultural liaison.

   **Response**: According to mine representatives, GMMC currently does not have a policy in place that emphasizes hiring Native American workers; however, they estimated that approximately 1 to 3 Native Americans are currently employed at the mine. Although no additional work force is expected to be needed under the proposed mine expansion, GMMC representatives agreed to look into the possibility of hiring more Native Americans in the future.

8. Bernice Lalo expressed concerns regarding transportation of chemicals used at the mine and the potential for a hazardous materials spill. She wondered if an Emergency Response Plan was in place and expressed concern that the Battle Mountain Band is often not notified when accidents/spills occur.

   **Response**: GMMC indicated that there is no local emergency response team although the mine has a trained HazMat team on site. An Emergency Response Plan is currently in place at the mine site. Discussions regarding hazardous materials and transportation are found in Section 3.13 of the EIS (Hazardous Materials). No impacts related to chemical transportation are anticipated as a result of the Proposed Action.

9. Tribal members are concerned about air pollution from cyanide evaporating from the leach pads and from dust created by mine operations. Erickson Hooper said that game will not forage in the area due to the dust on the grasses from mine operations. Tribal members said that when mining stops and the dust is gone, the wildlife would return.

   **Response**: Fugitive dust emissions and potential effects from cyanide are discussed in Section 3.3 of the EIS (Air Quality). No substantial effects to air quality are anticipated as a result of the Proposed Action.

10. Tribal members are concerned that sediment that is washed from the waste rock dump areas may be toxic.

    **Response**: Release of sediments from the waste rock dumps is not anticipated as a result of the Proposed Action. Reclamation efforts and controls, as described in Section 2.2.19 (Reclamation), should prevent deterioration of groundwater as a result of the Proposed Action.

11. Tribal members want to review archeological information for the area.

    **Response**: BLM confidentiality agreements conflict with the Tribe's need to pass on information about their cultural tradition. ***In an attempt to negotiate with the tribe, BLM offered a prototype agreement to share confidential information on cultural resources with Native Americans. The Battle Mountain Band found this unacceptable and did not sign an agreement. Therefore, BLM has not provided this information. BLM considers consultation closed.***

**Environmental Justice**

Since publication of Executive Order 12898, Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations in the Federal Register on February 11, 1994 (59 FR 7629), BLM has been developing a strategy for implementing the order. Currently, BLM relies on the environmental Justice Guidance Under the National Environmental Policy Act prepared by the Council on Environmental quality, in implementing EO 12898 in preparing NEPA documents.

EO 12898 requires identifying and addressing disproportionately high and adverse human health or environmental effects on minority populations and low-income populations. These requirements were addressed in preparing the Marigold Mine EIS by 1) ensuring broad distribution of public information on the Proposed Action through a public scoping process, and 2) conducting specific consultations with Native American communities (see Section 3.14.1.2).

The intent of the environmental justice guidance is to prevent discriminatory placement of projects in and around minority populations in comparison to non-minority communities. In the case of the Marigold Mine Project, the project is driven by the location of ore bodies, and BLM does not have the option of choosing another location for the project. In addition, no low-income or minority populations are located in the immediate mine area.

The baseline social and economic characteristics of the project area are discussed in Section 3.12.1. The project area population is predominantly Caucasian (approximately 83 percent in Humboldt County; 90 percent in Lander County) with minorities constituting approximately 17 and 10 percent of the County populations, respectively (U.S. Census 1990). The two Native American communities in these two counties are 1) the Winnemucca Colony, located on the edge of the town of Winnemucca in Humboldt County, approximately 30 miles to the northwest of the Marigold Mine Project area, and 2) the Battle Mountain Colony, located about 10 miles east of the project area near the town of Battle Mountain in Lander County. When Europeans first arrived in the region, the Battle Mountain region was a boundary area between the Northern Paiutes and Newe (the ancestors of the Western Shoshone). The modern colonies are descendant communities of these aboriginal groups.

There is relatively little economic opportunity on the Winnemucca and Battle Mountain reservations. At Battle Mountain, one source of tribal income is a smoke shop/convenience store. New mining activity in the area may increase business for this tribal enterprise. Section 3.12.2 of the Final EIS documents that the Marigold Mine Project would have insignificant economic and social impacts within the context of current conditions within Humboldt and Lander counties.

No significant adverse impacts that might differentially affect minority or low-income populations have been identified for most of the analyzed environmental factors. Because the local minority Native Indian communities are culturally affiliated with many archaeological sites, human remains, and traditional cultural places within the region, effects on these resources may represent differential levels of impacts to these local minority groups. Effects on such cultural resources are being considered in compliance with

numerous laws in addition to NEPA and are addressed in Section 3.14.2.1 of this EIS.

**Paleontology**

In addition to Federal requirements for protection of paleontological resources as identified in Section 3.14.1.3, the Society of Vertebrate Paleontology (SVP) has developed standard guidelines for the assessment and mitigation of adverse impacts to nonrenewable paleontological resources (Reynolds 1995). Notably the SVP defines protection of paleontologic resources to include:

a. Assessment of the potential for property to contain significant nonrenewable paleontologic resources, which might be directly or indirectly impacted, damaged, or destroyed by development, and

b. Formulation and implementation of measures to mitigate adverse impacts, including permanent preservation of the site and/or permanent preservation of salvaged materials in established institutions."

The project area has been evaluated for paleontological significance. Fossils occur in formations that are found in the project area; however, none of these occurrences are considered significant based upon rating techniques used by the Federal government and the SVP. Fossils previously found in the project area are common or have been transported outside of their original context area.

Significant fossil-bearing formations have not been identified in the areas of proposed project construction or operation; however, because fossils are usually buried, their locations cannot be confirmed until excavation or drilling occurs. If significant fossil deposits are located during construction or mine activities, ***GMMC*** has committed to contacting the proper authorities and preserving or avoiding the area as discussed in Section 2.2.18, Environmental Protection Measures.

Potential indirect impacts could result from improved access to fossil-bearing formations via improved access routes, including construction of exploration roads. Implementation of the environmental protection measures identified in Section 2.2.18 would reduce, but not eliminate impacts to paleontological resources. Following mine closure, indirect impacts are expected to be slightly reduced with the decrease in human activity in the area.

### 3.14.2.2 8-South Partial Pit Backfill Alternative

**Cultural Resources**

Impacts to cultural resources from the 8-South Partial Pit Backfill Alternative would be similar to those identified for the Proposed Action. No cultural resources have been identified in the 8-North Waste Rock Dump area.

**Native American Concerns**

Impacts to areas of concern to Native Americans from this alternative should be similar to those identified under the Proposed Action.

**Environmental Justice**

Impacts should be similar under this alternative to those identified under the Proposed Action.

**Paleontology**

Impacts to paleontological resources from the 8-South Partial Pit Backfill Alternative would be similar to those identified for the Proposed Action.

### 3.14.2.3 No Action Alternative

**Cultural Resources**

Under the No Action Alternative, impacts to cultural heritage resources from mine expansion and exploration would not occur. Continued erosional effects and illegal collecting would continue to occur

at a rate similar to what is currently taking place in the area.

**Native American Concerns**

Under the No Action Alternative, no impacts to Native American heritage resources would happen beyond those currently occurring as identified in Section 3.14.1, Affected Environment.

**Environmental Justice**

Under this No Action Alternative, no impacts beyond those currently identified as occurring would happen.

**Paleontology**

Under the No Action Alternative, no impacts to paleontological resources would happen beyond those currently occurring as identified in Section 3.14.1, Affected Environment.

## 3.14.3 Cumulative Impacts

### 3.14.3.1 Cultural Resources

As depicted in Map 3-18, the cumulative assessment area for cultural heritage evaluation includes the area from I-80 south to the county line.

Past, present and reasonably foreseeable future actions (RFFAs) within the cumulative assessment area that have involved or could involve effects to cultural resources include the Buffalo Valley Mine and Exploration Projects, the Lone Tree Mine Project, the Trenton Canyon Mine and Exploration Consolidation Projects, the past and present Marigold Mine Projects, the past and future Phoenix Mine Projects, the Converse Exploration Project, and the Brass Ring Exploration Project (see Table 2-9).

Including surveys completed within the proposed APE, 49 cultural resource inventories associated with past, present, and RFFAs have been conducted in the cumulative assessment area. These inventories have identified a total of 402 known cultural sites. These included 48 sites that are eligible to the Register with SHPO concurrence, 221 sites not eligible to the Register with SHPO concurrence, and 133 unevaluated sites that require concurrence from the SHPO or additional data collection.

The majority of past disturbance in the cumulative assessment area has consisted of historic mining operations or associated activities; they have in turn impacted an unidentified number of prehistoric and proto-historic sites. Historic and existing projects in the area have impacted at least 19 percent of the known cultural sites within the cumulative assessment area. This includes 21 sites previously affected by the Trenton Canyon Project, including 4 eligible sites, and 27 sites affected by the Lone Tree Mine Project, including 3 eligible sites (BLM 1995, 1998). Existing operations at the Phoenix Mine have impacted 27 sites, including at least 6 eligible sites. In addition, proposed activities at the Phoenix Mine could disturb 44 to 71 more sites.

Past operations at the Marigold Mine appear to have disturbed or destroyed three sites (Cr-NV-4244, -4245, and -4247). The proposed project may directly impact one eligible site. This equates to less than 1 percent of the total number of sites identified within the cumulative assessment area.

Current disturbances, including ongoing Marigold Mine operations, have been subject to cultural heritage resource protection laws. The majority of the areas have been surveyed to Class III standards for cultural heritage resources, and, in the case of current work, sensitive sites were avoided or impacts were mitigated. All mitigation actions associated with the proposed project would be in accordance with established guidelines and a project-specific treatment plan. between GMMC, BLM, the SHPO, and, if necessary, the Advisory Council on Historic Preservation (ACHP).

Future mining or other ground-disturbing activities within the cumulative assessment area could impact NRHP-eligible or unevaluated sites. As directed by law, cultural heritage resource inventories and

consultations would be conducted for any projects involving public lands, and impacts would be avoided or mitigated, as appropriate. Additional cultural inventories and consultations required for future expansions would add to the information base for cultural heritage resources within the cumulative assessment area. Compliance with Sections 106 and 110 of the NHPA would result in evaluation and mitigation or development of treatment plans for impacts to significant properties identified during the inventories for future actions and also would increase the overall knowledge of cultural heritage resources in the cumulative assessment area.

In any Federal undertaking, direct impacts to cultural heritage resources would be considered. Even with mitigation, physical destruction of sites could still occur in the future, and there could be a permanent loss of some cultural heritage sites. Permanent loss of sites also has occurred within the areas disturbed by past and present actions. Indirect impacts, such as vandalism and illegal collecting, have and could occur to cultural heritage resources through increased access and development, as a result of past, present, and future activities. Indirect effects to cultural resources by existing and future actions may be reduced, but not eliminated by implementing environmental protection measures or mitigation, such as those identified in this EIS.

#### 3.14.3.2 Native American Concerns

Disturbance to traditional lifeway values and the cultural identity of Native Americans and other ethnic groups have occurred as a result of developments associated with past projects and previous actions in the region. No Native American religious or traditional use areas have been currently identified within the Proposed Action area; so consequently, the Proposed Action would not contribute cumulatively to effects to traditional use or religious areas that have occurred under other actions. Cumulative effects discussions related to other areas of concern identified during Native American consultations, such as access, wildlife and water issues, and hunting (see Section 3.14.2 Cultural Resources Environmental Consequences) are provided in the following sections: Water Resources and Geochemistry, Section 3.1.3; Air Quality, Section 3.3.3; Vegetation, Section 3.5.3; Wildlife and Fisheries Resources, Sections 3.6.3 and 3.7.3; Range Resources, Section 3.8.3; Land Use and Access, Section 3.9.3; Recreation (hunting), Section 3.10.3; Aesthetics (noise and visual), Section 3.11.3; Social and Economic Values, Section 3.12.3; and Hazardous Materials, Section 3.13.3. No additional significant cumulative effects are anticipated for any of the above mentioned resources from implementation of the Proposed Action.

#### 3.14.3.3 Paleontology

No impacts to significant paleontological resources were identified as a result of the Proposed Action. Consequently, the Proposed Action would not contribute to cumulative impacts to paleontological resources.

### 3.14.4 Potential Mitigation and Monitoring

*Issue: Cultural surveys have not been completed in Sections 6, 7, 9, **16, 18, 19,** and 30 of Township 33 North, Range 43 East. Impacts to cultural resources can not be identified for these areas without surveys. If surveys indicate that significant cultural sites are present in these areas, appropriate mitigation should be implemented if direct disturbance is identified.*

Measure 1: Class III cultural surveys would be conducted in previously unsurveyed areas of Section 6, 7, 9, ***16,*** 18, 19, and 30 that could experience direct and indirect effects from the Proposed Action. If significant sites are identified that could be impacted, an appropriate treatment plan would be developed with the BLM and the SHPO.

Effectiveness: Surveys and appropriate mitigation, including treatment plans, would reduce, but not eliminate impacts to cultural resources in the surveyed areas.

Application: This measure would apply to the Proposed Action and the 8-South Partial Pit Backfill Alternative.

### 3.14.5 Residual Adverse Impacts

Direct and indirect impacts to NRHP eligible sites or other Federally or state-protected sites on Federal, state, or GMMC property would be prevented or reduced as provided for under the mitigation measures identified above. Residual impacts to cultural heritage resources, such as vandalism or illegal collecting, however, could result in the permanent loss of site context and traditional use, and could potentially result in the loss of information and artifacts.

No effects to significant paleontological resources have been identified as a result of the Proposed Action; therefore, no residual adverse effects are anticipated. No traditional cultural use localities or religious sites have been identified to date in the Proposed Action area; therefore, no residual adverse effects are anticipated for Native American issues.

## 3.15 Relationship Between the Local Short-Term Uses of the Human Environment and the Maintenance and Enhancement of Long-Term Productivity

Short-term is defined as the life of the proposed project through closure and reclamation (***2017***). Long-term is defined as the future beyond reclamation. Many of the impacts associated with the Proposed Action would be short-term and would cease following successful reclamation. Long-term soil and vegetation productivity under the Alternative is expected to be generally the same as under the Proposed Action. Soils, vegetation, and range resources would be lost in the unreclaimed pit areas (61 acres).

## 3.16 Irreversible/Irretrievable Commitment of Resources

Construction and operation of the proposed project would result in either the irreversible or irretrievable commitment of certain resources. Irreversible is a term that describes the loss of future options. It applies primarily to the effects of use of nonrenewable resources, such as minerals or cultural resources, or to those factors, such as soil productivity, that are renewable only over very long periods of time. Irretrievable is a term that applies to the loss of production, harvest, or use of natural resources. For example, livestock forage production from an area is lost while an area is serving as a mining area. The production lost is irretrievable, but the action is not irreversible. If the use changes and the mine is reclaimed, it is possible to resume forage production. Irreversible and irretrievable impacts of the Proposed Action are summarized in Table 3-29.

**Table 3-29**
**Irreversible/Irretrievable Commitment of Resources - Proposed Action**

| Resource | Irreversible Impacts | Irretrievable Impacts | Explanation |
|---|---|---|---|
| Water Resources and Geochemistry | No | Yes | Water that is removed during the life of the project and used for mine operations would not be available for other uses. |
| Geology and Minerals | Yes | Yes | Mineral resources that are mined would no longer be available for future production. |
| Air Quality | No | No | Emissions from the project would not deteriorate the existing air quality in the project vicinity. |
| Soils | No | No | Soils from the pits, waste rock dumps, heap leach pads, tailings impoundment, and other mine facilities would be salvaged as growth media for use in reclamation. |
| Vegetation Resources | Yes | Yes | Irreversible impacts to vegetation would result in the unreclaimed pit areas (61 acres). |
| Wildlife and Fisheries Resources | Yes | Yes | Wildlife habitat would be irreversibly lost in the unreclaimed pit areas (61 acres). |
| Special Status Species | Yes | Yes | About 674 acres of potential habitat (shadscale and sagebrush vegetation type) for the burrowing owl ***and sage grouse*** would be irretrievably lost until after reclamation. Bat habitat would be removed at the Red Rock Pit. |
| Range Resources | Yes | Yes | Unreclaimed pit areas (61 acres) would be irreversibly lost for livestock grazing. There would be an irretrievable loss of public land available for livestock grazing, (about 5,762 acres, or 288 animal unit months) until reclamation is sufficient to restore productivity and allow this activity to resume. Forage production is expected to recover in the long-term following reclamation, with a loss of 6 animal unit months. |
| Land Use and Access | No | No | There would be no irreversible impacts to access; public access patterns would be maintained. |

Table 3-29 (Continued)

| Resource | Irreversible Impacts | Irretrievable Impacts | Explanation |
|---|---|---|---|
| Recreation | No | Yes | The loss of the unreclaimed pit areas (61 acres) would minimally affect recreation. There would be an irretrievable loss of land available for dispersed recreational opportunities until reclamation is sufficient to allow dispersed recreational activities to resume. |
| Aesthetics | No | Yes | Impacts to visual resources would be eliminated through successful reclamation procedures. |
| Social and Economic Values | No | Yes | The eventual loss of employment, tax revenues, and other economic benefits following mine closure would be considered temporary over the long-term, as other sources of employment and tax revenues would likely be obtained. |
| Hazardous Materials | No | No | A spill of hazardous materials into a sensitive resource, such as a stream or wetland, is not expected during the life of the project. If a spill did occur, impacts could last for several months or years, but would not be considered irreversible. Remediation of a spill would be initiated immediately and would be expected to mitigate most impacts. |
| Cultural Resources, Ethnography | Yes | Yes | Disturbance of cultural sites would result in the permanent loss of site context. Continued mine operation has an adverse effect on traditional values of local Native American groups. |
| Paleontology | No | No | No disturbance to paleontological resources is expected. If paleontological resources are encountered they would be avoided where possible. If avoidance is not possible, irreversible and irretrievable impacts would result. |

# 4.0 CONSULTATION AND COORDINATION

## 4.1 Public Participation

The public participation program for this EIS includes the following components.

Two public scoping meetings were held for the EIS, one on October 6, 1998 and one on October 7, 1998, in Battle Mountain and Winnemucca, respectively. Public scoping comments for the EIS were received through December 18, 1998.

To date, nine written comment letters have been received by the BLM. The public scoping meeting comments were summarized and addressed in the EIS Preparation Plan. The following are the key scoping issues for the Marigold Mine Expansion Project.

- Water quality impacts associated with heap leach expansion and pit lakes;
- Impacts from dewatering and water use;
- Cumulative impacts to water sources, air quality, vegetation, and wildlife;
- Impacts to visual resources;
- Reclamation and revegetation using native species;
- Impacts to wetlands and riparian areas;
- Impacts associated with stream diversions;
- Impacts to sensitive biological resources;
- Wildlife exposure to cyanide solutions;
- Reduction in availability of grazing land and water access for livestock;
- Control of noxious weeds;
- Potential traffic impacts associated with construction and operation of the proposed project;
- Legality of mining claims;
- Pit backfilling alternatives; and
- Relocation of county road and power line.

***During the 60-day public comment period, comments on the Draft EIS were submitted at the public meetings held in Battle Mountain and Winnemucca, Nevada, on March 8 and 9, 2000, respectively. Formal comment letters were not submitted at these meetings. However, verbal comments were provided at the Winnemucca meeting by Tom Meyers of the Great Basin Mine Watch. His comments included the following topics:***

- ***Legality of mining claims;***
- ***Pit backfilling alternatives;***
- ***Water quality impacts associated with existing tailings impoundment, waste rock dumps, heap leach expansion, and pit lakes; and***
- ***Air emissions.***

## *4.2 Native American Consultation*

***This section summarizes the process to gather information from Native Americans potentially affected by the proposed expansion of the Marigold Mine. A complete report (Marigold Mine Native American Consultation Summary Report [ENSR 1999]) detailing the information gathering process has been prepared and is available at the BLM office in Winnemucca, Nevada. Copies of the summary report also have been provided to representatives of the Native American groups interviewed during the process.***

***Native American consultation was conducted to comply with Federal and state laws that apply to resources with traditional and/or religious significance to Native Americans.***

***Consultation was initiated with notification letters outlining the proposed mine expansion. Notification letters and requests for comments were sent by the BLM in March 1999 to various Native American tribal groups.***

***Following issuance of these letters, a meeting concerning the proposed action was requested by and arranged with the Battle Mountain Band.***

***BLM and GMMC presented an informational meeting to the Battle Mountain Band on the proposed action on May 27, 1999, in Battle Mountain, Nevada. During the meeting, a request for a mine tour was made. The Marigold Mine tour was held on July 28, 1999. The BLM sent follow-up letters making a final request for meetings, comments, and/or input in September and October 1999 to the Battle Mountain Band Council. Follow-up telephone contacts were made throughout the process by the BLM and the BLM's ethnography contractor to identify tribal governments and individuals that wanted more information and to set up meetings and a tour of the mine site. Concerns identified during the meeting, mine tour, and during telephone conversations were recorded in the summary report and evaluated in the EIS.***

***Specific information regarding the Native American consultation process has been provided in Section 3.14.1.2, Ethnography and Native American Consultation.***

## 4.3 Draft Environmental Impact Statement Preparation

In preparing the Draft EIS, the BLM communicated with and received input from many Federal, state, and local agencies, as well as other organizations and individuals. The following is a list of those who provided input:

**Federal Government Agencies**

U.S. Department of Commerce, Bureau of the Census
U.S. Fish and Wildlife Service (Reno)

**State Government Agencies/Universities**

Nevada Bureau of Mines and Geology
Nevada Department of Administration
Nevada Department of Conservation and Natural Resources, Nevada Division of Wildlife (Elko, Winnemucca)
Nevada Department of Conservation and Natural Resources, Division of Historic Preservation and Archaeology
Nevada Department of Employment, Training, and Rehabilitation-Research and Analysis Bureau and Employment
Security Division
Nevada Department of Taxation
Nevada Natural Heritage Program (Carson City)
Nevada State Demographer's Office, Bureau of Business and Economic Research

**Local Governments/Agencies**

Tri-County Development Authority

## 4.4 *Final* Environmental Impact Statement Review

Approximately 380 copies of the Draft ***EIS and 480 copies of the Final EIS*** were distributed to various government agencies, organizations, and individuals. A listing of the agencies, organizations, and individuals who received copies of the ***Final*** EIS in ***March 2001*** is presented below.

**Agencies, Organizations, and Individuals Who Received Copies of the *Final* Environmental Impact Statement**

Government Agencies

Commander, National Training Center – Ft Irwin, CA
HQ-USAF/LEEV - Bolling AFB - Washington, DC
Office of the Deputy A/S of the USAF; Environmental, Safety, Occupational Health - Washington, DC
U. S. Army Corps of Engineers - San Francisco, CA; Reno, NV

U. S. Department of Energy; Office of Environmental Compliance (EH-23) - Washington, DC
U.S. Department of Transportation, Environmental Division – Washington, DC
U. S. Environmental Protection Agency, Region IX - San Francisco, CA
U.S. Environmental Protection Agency, NEPA Compliance Division, EIS Filing – Washington, DC
USDA, Forest Service - Winnemucca, NV
USDA/NRCS Rangeland Mgmt./Resource Specialist - Winnemucca, NV
USDI/Bureau of Indian Affairs - Elko, NV
USDI/Bureau of Land Management - Reno, NV; Elko, NV; Carson City, NV; Las Vegas, NV; Ely, NV; Battle Mountain, NV; Tonopah, NV; Cedarville, CA; Ridgecrest, CA; Denver, CO; Washington, DC
USDI/Bureau of Land Management, National Applied Resource Science Ctr. - Lakewood, CO
USDI/Bureau of Reclamation – Denver, CO
USDI/Fish and Wildlife Service - Washington, DC; Portland, OR; Reno, NV
USDI/Minerals Management Service - Washington, DC
USDI/MMS-RMP - Denver, CO
USDI/National Park Service - Washington, DC
USDI/Natural Resources Library - Washington, DC
USDI/Office of Environmental Policy & Compliance - Washington, DC
USDI/Office of Public Affairs - Washington, DC
USDI/Office of Surface Mining - Washington, DC
USDI/USGS - Denver, CO; Carson City, NV; Reston, VA

State Agencies

Nevada Bureau of Mines and Geology – Reno, NV
Nevada Department of Transportation - Winnemucca, NV
Nevada Div. of Environmental Protection, Bureau of Mining Regulation and Reclamation - Carson City, NV
Nevada Division of Minerals - Carson City, NV
Nevada Division of State Lands - Carson City, NV
Nevada Division of Wildlife - Reno, NV; Fallon, NV; Winnemucca, NV; Elko, NV
Nevada State Engineer, Division of Water Resources - Carson City, NV
State Historic Preservation Office - Carson City, NV
State of Nevada Clearinghouse - Carson City, NV
State of Nevada Dept. of Conservation & Natural Resources - Carson City, NV
State of Nevada Governor's Office - Carson City, NV
State Planning Coordinator, State of Nevada, Dept. of Administration - Carson City, NV

Local Agencies

City of Winnemucca - Winnemucca, NV
Elko County Commissioners – Elko County, NV
Elko County Library - Elko, NV
Eureka Branch Library – Eureka, NV
Eureka County Commissioners – Eureka, NV
Eureka County Deputy District Attorney – Eureka, NV
Eureka County Public Works – Eureka, NV
Humboldt County Commissioners - Winnemucca, NV
Humboldt County Library - Winnemucca, NV
Humboldt River Basin Water Authority - Carson City, NV; Winnemucca, NV
Lander County Commissioners - Battle Mountain, NV 89820
Lander County District Attorney – Battle Mountain, NV
Lander County Library - Battle Mountain, NV
Lovelock Water District – Lovelock, NV
Pershing County Commissioners - Lovelock, NV
Pershing County Library - Lovelock, NV
Pershing County Water District - Lovelock, NV
Winnemucca City Manager - Winnemucca, NV

Elected Officials

Honorable John Marvel, State Assemblyman - Battle Mountain, NV; Carson City, NV
Honorable Dean Rhoads, State Senator - Carson City, NV; Tuscarora, NV
Honorable Richard Bryan - Washington, DC
Honorable James Gibbons - Reno, NV
Honorable Harry Reid - Reno, NV
Honorable Paul Vesco, Mayor - Winnemucca, NV

Tribal Organizations

Battle Mountain Band Council of the Te-Moak Tribe of Western Shoshone - Battle Mountain, NV
***Bureau of Indian Affairs – Carson City, NV***
Duck Valley Shoshone – Paiute Business Council - Owyhee, NV
The Te-Moak Tribe of Western Shoshone – Elko, NV
Fort McDermitt Tribal Council - McDermitt, NV
Nevada Indian Environmental Coalition - Reno, NV
Winnemucca Colony Tribal Council - Winnemucca, NV
Western Shoshone History Preservation Society - Elko, NV
Western Shoshone National Council - Duckwater, NV
Western Shoshone Defense Project – Crescent Valley, NV
Western Shoshone Resources, Inc. – Reno, NV
Yomba Shoshone Tribe – Austin, NV

Organizations

Animal Protection Institute of America - Sacramento, CA
Audubon Society, Lahontan Chapter - Reno, NV
Center for Urban Affairs and Policy Research - Evanston, IL
Citizen Alert, Native American Program - Reno, NV
Colorado State University Libraries - Fort Collins, CO
Desert Research Institute - Reno, NV
***Great Basin Mine Watch – Reno, NV***
Indigenous Affairs International Work Group - Copenhagen DENMARK
Institut fuer Bergbau - Federal Republic of Germany
La Puente Gem and Mineral Club - La Puente, CA
LASER, Inc. - Gridley, CA
McGill University, Department of Geography - Montreal, Quebec CANADA
Mineral Policy Center - Washington, DC
National Wildlife Federation - Portland, OR
National Wildlife Federation - Washington, DC
Nature Conservancy - Reno, NV
Natural Resources Defense Council – San Francisco, CA; Washington, DC
Nevada Building and Construction Trades Council - Portland, OR
Nevada Cattlemen's Association - Elko, NV
Nevada Mining Association - Reno, NV
Nevada Outdoor Recreation Association - Carson City, NV
Nevada Woolgrower's Association - Elko, NV
Santa Clara Valley Gem and Mineral Society - San Jose, CA
***Sierra Club, California/Nevada RCC Mining Committee – Independence, CA***
Sierra Club, Great Basin Group - Reno, NV
Sierra Club, Toiyabe Chapter - Reno, NV
Sierra Club Legal Defense Fund - Denver, CO
Southwest Center for Biological Diversity - Tucson, AZ
SWRIC – Albuquerque, NM
Trout Unlimited, Sagebrush Chapter - Reno, NV
University of Nevada - Reno, NV
University of Nevada Libraries - Reno, NV
University of Nevada, Reno, Mackey School of Mines - Reno, NV
Wild Horse Organization Assistance – Reno, NV
Wild Horses Commission – Carson City, NV
Wildlife Society, Nevada Chapter - Elko, NV
Women in Mining - Winnemucca, NV

Industries/Businesses

Agri Beef Company - Boise, ID; Golconda, NV
AILA – New York, NY
Alpha Analytical, Inc. – Sparks, NV
American Assay Labs - Sparks, NV
Ballard Spahr Andrews & Ingersoll - Denver, CO
Battle Mountain Bugle – Battle Mountain, NV
BHP Copper – Tucson, AZ
***Coeur Rochester, Inc. – Lovelock, NV***
Concerned Citizen for Responsible Mining – Ontario, OR
Cordex Exploration Company - Reno, NV
Cortez Gold Mine – Beowawe, NV
Dames & Moore - Lompac, CA
Death Valley Gateway Gazette – Pahrump, NV
Echo Bay Minerals Company, McCoy Mine - Battle Mountain, NV
Elko Free Press - Elko, NV
Ellison Ranching Company, Spanish Ranch - Tuscarora, NV

***EMA – Elko, NV***
Emmons & Associates, Inc. – Salt Lake City, UT
Environmental Management Associates – ***Elko***, NV
Environmental Strategies, Inc. – Denver, CO
Filippini Ranching Co. – Battle Mountain, NV
Geological and Environmental Consulting – Three Forks, MT
Getchell Gold, Getchell Mine - Golconda, NV
Goldfield Mining Corp. – Golden, CO
Greystone - Englewood, CO
Happy Creek Land and Cattle Company - Elko, NV
Hecla Mining - Coeur d'Alene, ID
Holme, Roberts & Owen - Denver, CO
Homestake Mining Company – San Francisco, CA
Humboldt Sun – Winnemucca, NV
Hycroft Mine - Winnemucca, NV
Independence Mining Co. – Elko, NV
Independence Mining Corp. – Englewood, CO
JBR Environmental Consultants – Reno, NV; Springfield, UT
Kinross Sleeper Mine - Winnemucca, NV
Mineral Policy Center – Bozeman, MT
Muys & Pensabene, P.C. - Washington, DC
Nevada Gold Mining Inc. - Winnemucca, NV
Nevada Mining Association – Reno, NV
Newmont Gold Company - Carlin, NV
Newmont Gold Company, Twin Creeks Mine – Golconda, NV
Newmont Mining Corporation - Denver, CO; ***Winnemucca, NV, Valmy, NV***
PTI Environmental Services - Bellevue, WA
Pacific Southwest Bioservices - National City, CA
Parsons Behle & Latimer - Salt Lake City, UT
Phelps Dodge Corporation - Lincoln, MT; Phoenix, AZ
Placer Dome – Golconda, NV
Planning Information Corp. – Denver, CO
Public Lands Foundation – Arlington, VA
Sage Engineering - Reno, NV
Sheep Creek Ranch – Carlin, NV
Sierra Pacific Power Company - Reno, NV
Steffen Robertson and Kirsten - Reno, NV
The Industrial Company – Carson City, NV
The Ranch House – Crescent Valley, NV
WESTEC - Reno, NV
Western States Mineral Corporation - Reno, NV

Individuals

Mark Abrams – Reno, NV
Monica Antonovich – Reno, NV
Hale Bailey – Carlin, NV
Dan Banghart – Elko, NV
Didi Benede-Dann – Crescent Valley, NV
Dirf Benford – Crescent Valley, NV
Mark Bennett – Battle Mountain, NV
Scott Benson - Laramie, WY
Mark Blair – Elko, NV
M. Bradley – Reno, NV
Joy K. Brandt – Austin, NV
George Brown - Mead, WA
Joe Brown – Reno, NV
Robert Brown - Manteca, CA
Brian Buck - Sandy, UT
John Bunch – Elko, NV
Ralph Bunch – Elko, NV
John Burrows – Elko, NV
Gregg Bush – Elko, NV
Gail Callan – Portland, OR
Jay Callisto – Verdi, NV
Anthony Cardinalli – Reno, NV
Jack Cardinalli – Carson City, NV
John C. Carpenter – Elko, NV
Ken Carson – Battle Mountain, NV
Larry Carson – Battle Mountain, NV
Joel Casburn – Zephyr Cove, NV
Rocky Chase - Beatty, NV
James Chavis – Elko, NV
Jack Chesney – Sparks, NV
Vic Chevillon – Reno, NV
Lindsay Craig – Reno, NV
Kenneth D. Cunningham – Reno, NV
JoAnne W. Curtis – Reno, NV
Vivian Curtis – Reno, NV
Carrie Dann - Crescent Valley, NV
Pete A. Dilles – Sparks, NV
Paul Dobak – Elko, NV
Darrell G. Dugan – Crescent Valley, NV
Shane Edgar – Battle Mountain, NV
LeRoy Etchegaray – Eureka, NV
John Etchegaray – Eureka, NV
Leonard L. Evans – Crescent Valley, NV
Don and Eddyann Filippini - Battle Mountain, NV

John and Billie Filippini, Beowawe, NV
J. D. and Steven Foster – Reno, NV
Jack Fullenwider - Golconda, NV
Rodney Gettig - Sacramento, CA
Debbie Gibson – Elko, NV
Jeff Green – Sandy, UT
Tom C. Griswold – Crescent Valley, NV
Joe Guild - Reno, NV
Dennis Gunn – Reno, NV
Royce L. Hackworth – Elko, NV
Corbin Harney – Battle Mountain,NV
Charlie Harper – Beowawe, NV
Eugene L. Haub – Elko, NV
Charlotte and Harvey Healy - Wells, NV
Alan Hitchborn – Elko, NV
Fred Hornbarger – Elko, NV
Joe Jarvis – Cedar City, UT
Chuck Jeannes – Reno, NV
Bob Johnson – Reno, NV
Dave Johnson – Elko, NV
Roger Johnson - Winnemucca, NV
Scott Johnson - Sparks, NV
Walter Johnson – Austin, NV
Bruce Johnston – Gearhart, OR
Benita and L. A. Jones – Crescent Valley, NV
Helen Irene Jones – Reno, NV
Jerry Jones – Elko, NV
Tilman Jones – Austin, NV
W. C. Jones – Golden, CO
Doris Kaesz – Los Angeles, CA
Conrad and Doris Kersch – Stagecoach, NV
Paul Kersnowski - Lovelock, NV
Ann Kersten – Sparks, NV
Jeanne King - Battle Mountain, NV
Rick Lassen – Reno, NV
Nathan Lauritzen – Battle Mountain, NV
Tony and Nancy Lesperance – Elko, NV
Jon Liechty – Bloomington, IN
Marrianna Lipe – Crescent Valley, NV
Gregg Loptien – Sparks, NV
Susan Lynn - Reno, NV
Florine Maine - Battle Mountain, NV
Merlin McColm – Elko, NV
Robert D. McCracken – Las Vegas, NV
Gary G. McGill – Elko, NV
Thomas Metcalf – Albuquerque, NM
Douglas Miller - Carson City, NV
Glenn Miller - Reno, NV
Donald A. Molde – Reno, NV
George and Barb Montgomery – Crescent Valley, NV
Terry Munson – Elko, NV
Tom Myers - Reno, NV
Tina Nappe - Reno, NV
Hal Orton – Carlin, NV
Norman and Adell Panning – Beowawe, NV
D. P. Parker – Reno, NV
Dave Parker – Reno, NV
Mike & Adrienne Parsons - Imlay, NV
Wil Patrick – Bozeman, MT
B. Patsch – Reno, NV
Lance A. Paul – Elko, NV
Kenneth Paulsen - Arvada, CO
Mike Peterson – Republic, WA
Jeff Petragilia - Manassas, VA
Mike Podborny – Eureka, NV
Matt Potter – San Diego, CA
Randy Powell – Elko, NV
Todd Process – Reno, NV
Belinda Quilici - Lovelock, NV
Larry Reynolds - Carson City, NV
Deborah Rhine – Denver, CO
Matthew Riley – Cave Junction, OR
Carolyn and John Ross – Elko, NV
Chris Rudnick – Winnemucca, NV
Andy Schumacher – Elko, NV
Gaylen Schwartz – Crescent Valley, NV
Laura Mae and Jay Scott – Crescent Valley, NV
Diane Seaborg – Lafayette, CA
James D. Sefton – Crescent Valley, NV
Nancy Sellard – Crescent Valley, NV
Chris Sewall - Cresent Valley, NV
Marjorie Sill - Reno, NV
Eve Spoo – Crescent Valley, NV
Gaylyn Spriggs - Valmy, NV
Roger Steininger – Reno, NV
Cliff Stewart – Battle Mountain, NV 89820
Claus Stoiber – Valmy, NV
Debra Struhsacker - Reno, NV
Sharon Sweeney - Winnemucca, NV
Sharon Swisher – Lamoille, NV
Edward S. Syrjala - Centerville, MA
Greg Taylor - Battle Mountain, NV

Tom Temkin – Reno, NV
Rachel Thomas - Huachuca City, AZ
Charlene Toomer - Arlington, VA
Kim Townsend – Duckwater, NV
Andrea Turman – Virginia City, NV
John H. Uhalde – Reno, NV
Richard Waldemar – Battle Mountain, NV
Dowell O. Ward – Crescent Valley, NV
Stephanie Weigel – Baton Rouge, LA
Terry White – Reno, NV
Jane Williams – Rosamond, CA
Ray H. Williams, Jr. – Austin, NV
Edie Wilson – Newark Valley, NY
Tim Wilson – Reno, NV
Jay C. Winrod – Austin, NV
Cy Wisley – Sparks, NV
Elwood Wright – Crescent Valley, NV
Alan Yoshida – Reno, NV

## 4.5 Public Comment Letters and Responses

***Table 4-1 lists each of the comment letters by organization and reference number assigned to each letter. Each comment is identified by a bracket and reference number, which is keyed to the letter reference number. Thus, Comment 7-1 refers to the first comment in Letter 7. The response to each comment accompanies the transcript by the reference number of the respective comment (e.g., response to Comment 7-1).***

**Table 4-1**
**Public Comment Letters**

| Letter Number | Organization |
|---|---|
| 1 | U.S. Fish and Wildlife Service |
| 2 | U.S. Environmental Protection Agency |
| 3 | Nevada State Clearinghouse |
| 4 | U.S. Geological Survey |
| 5 | Nevada Division of Wildlife |
| 6 | Western Shoshone Defense Project |
| 7 | Great Basin Mine Watch |
| 8 | Mineral Policy Center |
| 9 | Sierra Club |
| 10 | Newmont Mining Corporation |

# Letter 1

United States Department of the Interior

FISH AND WILDLIFE SERVICE

NEVADA FISH AND WILDLIFE OFFICE
1340 FINANCIAL BOULEVARD, SUITE 234
RENO, NEVADA 89502-7147

April 10, 2000
File No. BLM 10-4

Memorandum

To: Field Manager, Bureau of Land Management, Winnemucca, Nevada

From: Field Supervisor, Nevada Fish and Wildlife Office, Reno, Nevada

Subject: Draft Environmental Impact Statement - Marigold Mine Expansion Project

We have reviewed the Draft Environmental Impact Statement (DEIS) for the Marigold Mine Expansion Project. This DEIS analyzes impacts associated with a proposal by Glamis Marigold Mining Company (GMMC) to continue and expand gold mining operations at the Marigold Mine in Humboldt County, Nevada. The proposed action includes: expansion of two pits and development of two new pits; expansion of two waste rock dumps and development of two new waste rock dumps; development of a new heap leach facility and expansion of existing heap leach pads; construction of a new tailings impoundment and expansion of the existing tailings impoundment; construction of miscellaneous ancillary facilities; and exploration disturbance. The following comments are provided for your consideration.

**GENERAL COMMENTS**

1-1 We support the 8-South Partial Pit Backfill Alternative. This alternative would eliminate the need to construct the 8-North Waste Rock Dump (85 acres). As a result, the total land disturbance would be 632 acres rather than 717 acres. We recommend minimizing disturbance to shrub communities to the greatest extent possible to reduce potential impacts to sage grouse. Further explanation of our support for this alternative can be found in our comments of page 2-38 (2.3 8-South Partial Pit Backfill Alternative).

# Responses to Letter 1

1-1 The Agency-Preferred Alternative is the 8-South Partial Pit Backfill Alternative as described in the EIS.

# Letter 1 Continued

Field Manager File No. BLM 4-10

SPECIFIC COMMENTS

CHAPTER 2. PROPOSED ACTION

1-2 2.2.2.2 Proposed Action, Mining Operations, Surface Water Diversions (page 2-12): In addition to providing comments on this DEIS, we may comment on any notice issued by the U.S. Army Corps of Engineers for a permit under section 404 of the Clean Water Act.

1-3 2.2.4.2 Proposed Action, Waste Rock, Pit Backfill (page 2-15): It is not sufficient to only consider release of metals. Non-metallic constituents may also be released and may be of concern regarding surface water or ground water. We agree that the potential for generation of acid rock drainage must be minimized; however, minimizing the potential impact in and of itself may not be protective of these waters.

1-4 2.2.10 Proposed Action, Storm Water Control (page 2-21): It appears that all storm water from waste rock dumps will be directed to storm water ponds. Storm water should be monitored to determine if it contains elevated concentrations of metals or trace elements.

1-5 2.2.18.3 Proposed Action, Environmental Protection Measures and Monitoring, Spill Prevention Sampling, Storm Water Discharge (page 2-26): The frequency of sampling should be indicated in this section. Sampling of storm water events would be preferred.

1-6 2.2.18.5 Proposed Action, Environmental Protection Measures and Monitoring (Page 2-27): We support GMMC's commitment to survey for breeding birds prior to ground disturbance. Destruction of active bird nests or young of birds that breed in the area may be in violation of the Migratory Bird Treaty Act (MBTA) (15U.S.C. 701-718h). Under the MBTA, active nests (nests with eggs or young) of migratory birds may not be harmed, nor may migratory birds be killed.

We recommend that the first sentence of the second full paragraph on the page be reworded to ensure that all suitable habitats are surveyed for breeding birds, as opposed to "suitable native habitats" currently specified in the sentence.

1-7 2.2.19.8 Proposed Action, Reclamation, Facility Reclamation, Heap Leach Pads (page 2-35): We request the opportunity to review draft NEPA documents regarding the expanded fresh water rinse with bacterial neutralization and the Greenworld Science Method heap neutralization processes if either is used.



# Responses to Letter 1

1-2 Comment noted.

1-3 The Meteoric Water Mobility Procedure tests would evaluate and determine the levels of metallic and non-metallic constituents within waste rock. Metallic and non-metallic constituents within surface and groundwater are regulated by the State of Nevada and EPA guidelines. Both metallic and non-metallic constituent levels within waste rock would meet the water quality standards before use as pit backfilling material. The phrase, "and non-metals," was added to the third paragraph in Section 2.2.4.2, Pit Backfill, as a result of the comment.

1-4 Additional information regarding storm water monitoring and sampling has been provided in Section 2.2.10, Storm Water Control, as a result of the comment.

1-5 See response to Comment 1-4.

1-6 Based on your comment, the text in Section 2.2.18.5, Wildlife and Livestock Protection, on page 2-27 has been modified to indicate that all suitable habitats would be surveyed for breeding birds.

1-7 Comment noted. The BLM would require a new National Environmental Policy Act (NEPA) analysis in the event a proposal was presented to close the heap leach pads using the Greenworld Science Method. BLM would coordinate with the U.S. Fish and Wildlife Service in reviewing applicable NEPA documents with regard to the Greenworld Science technology and closure of the heap leach pads.

# Letter 1 Continued

Field Manager File No. BLM 4-10

1-8 2.3 8-South Partial Pit Backfill Alternative (page 2-38): We support this alternative because without it the pit would likely support a shallow ephemeral lake or marsh-like system. An aquatic community would likely form in the lake which will have elevated concentrations of arsenic and mercury in the water. Arsenic will bioaccumulate and mercury will biomagnify in aquatic food chains and can lead to excessive exposure of wildlife, including migratory birds. This partial backfill should be conducted even if the 8-North Pit is not developed and should be a part of the Proposed Action or a condition or stipulation in the Plan of Operations.

CHAPTER 3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

1-9 Table 3-1 (page 3-6): Some of the aquatic life standards (e.g., arsenic, chromium and mercury) appear to be in error. Also, to the best of our knowledge, the aquatic life standard for boron has been dropped. The standard for molybdenum is missing. Please contact the Nevada Division of Environmental Protection to obtain the correct standards.

1-10 3.1.1.4 Water Resources and Geochemistry, Affected Environment, Groundwater Resources, Tailings Impoundment Hydrology (page 3-23): We are concerned that seepage from the tailings impoundment has reached the alluvial groundwater aquifer. This situation must be closely monitored and further steps taken, if needed, to prevent further spread of the plume, that if left unchecked might reach the Humboldt River. The early establishment of a new lined tailings facility may be needed.

1-11 3.1.1.4 Water Resources and Geochemistry, Affected Environment, Groundwater Resources, Lone Tree Mine Dewatering and Water Level Declines at the Marigold Mine (page 3-25): The inadequacy of the original groundwater model for the Lone Tree Mine points to the need for improved models and continued monitoring to determine actual trends.

1-12 3.1.2.1 Water Resources and Geochemistry, Environmental Consequences, Proposed Action, Geochemistry Impacts, Heap Leach Facility (page 3-29): We question the use of land application of rinsate because of the potential to contaminate groundwater. If land application is to be used, elevated concentrations of metals and trace elements in rinsate should be evaluated to determine if they may adversely affect vegetation or be taken up in vegetation, thereby exposing wildlife. This information should be included in the sections on Vegetation Resources and Wildlife and Fisheries Resources.



# Responses to Letter 1

1-8 A mitigation measure provided in Section 3.1.4, Potential Mitigation/Monitoring, has been added to allow for the partial backfill of the existing 8-South Pit above the estimated water table. This measure would be implemented even if the 8-North Pit is not developed. Implementation of this measure would avoid the formation of a pit lake and potential exposure of elevated concentrations of arsenic and mercury to wildlife.

1-9 Table 3-1 has been revised to reflect the current Nevada water quality standards as established by Nevada Department of Environmental Protection (NDEP).

1-10 The tailings facility is on private land. Therefore, NDEP has the primary responsibility for ensuring that the seepage from the facility is monitored and controlled to protect the waters of the State. It is expected that the impoundment would not be used for approximately 3 years. The northern section of the impoundment that is leaking would not be used under the Proposed Action and would be allowed to drain under the supervision of the NDEP. Tailing seepage is currently being monitored by GMMC under the supervision of NDEP. The seepage is elevated in TDS, chloride, nitrate, barium, and WAD cyanide. However, the alluvial groundwater has shown increases only in TDS and chloride, which are still within Nevada drinking water standards. If groundwater should become elevated in constituents beyond the drinking water standards, GMMC is committed to remediation of the groundwater until seepage from the tailings facility has been abated.

1-11 GMMC has developed a groundwater monitoring plan, which has been approved by the BLM, to monitor groundwater levels at the mine. The groundwater model for the Lone Tree Mine has been revised to incorporate the changes in groundwater levels at the Marigold Mine and is now considered more accurate by the BLM for predicting post-mining groundwater levels. The original groundwater model for the Lone Tree Mine utilized the data available at the time of model construction and was reasonably accurate in predicting the amount of water needed for dewatering the Lone Tree pit. The cone of depression in the original model was less accurate due to a lack of data outside of the Lone Tree Mine area. Acquisition of that data had led to a more accurate 1999 version model that would predict impacts to the Marigold Mine with more certainty (HCI 2000). As more data are gathered over the next 10 years, the Lone Tree groundwater model would be updated to ensure the most accurate estimate of groundwater impacts. Please refer to the following reference for additional information regarding the Lone Tree groundwater model.

HCI (2000). 1999 Update to Numerical Groundwater Flow Modeling for Newmont's Lone Tree Mine, Humboldt County, Nevada.

1-12 The Proposed Action does not include land application of heap leach rinsate. The BLM would require a separate NEPA analysis in the event a land application proposal is received as part of closure activities. Appendix A outlines BLM's current guidance with respect to heap leach closure activities.

# Letter 1 Continued



1-13 3.3.2.1 Air Quality, Environmental Consequences, Proposed Action (page 3-60): We are concerned with the estimated emission of 2.09 tons of mercury per year. Additional monitoring is needed to determine the actual emission rate. The source of the emission should be stated. Mitigation is needed to reduce the mercury emission because it could contaminate aquatic environments off site and have adverse effects on aquatic biota and migratory birds. Also, residual adverse effects are likely from past, ongoing, and future mercury emissions.

1-14 3.5.1.1 Vegetation Resources, Affected Environment, Vegetation (page 3-79): In the description of the shadscale-cheatgrass community, cheatgrass is incorrectly identified as a perennial grass. The sentence "In addition to cheatgrass, other common perennial grasses include . . . ." should be reworded.

1-15 3.5.2.1 Vegetation Resources, Environmental Consequences, Proposed Action (page 3-82): Information should be provided on the type of vegetation that is expected in the bottom of the 8-South Pit.

1-16 3.6.2.1 Wildlife and Fisheries, Environmental Consequences, Proposed Action (page 3-89): Although the risks of mortality may be small, birds will be exposed to cyanide solutions for a greater period, both at the tailings impoundment and from possible puddling on heaps. The potential for sub-lethal effects should also be acknowledged (see Ma and Pritsos 1997; Pritsos and Ma 1997), as well as the possibility of delayed mortality of birds (Henny et al. 1994).

1-17 3.6.2.1 Wildlife and Fisheries, Environmental Consequences, Proposed Action (page 3-90): We disagree with the conclusion that there will be no adverse, long-term effects to wildlife resources from the development of a lake in the 8-South Pit. The shallow nature of the lake with its seasonal occurrence may lead to the development of an ephemeral wetland, with the development of an aquatic community. The community would have the potential to biomagnify mercury and bioaccumulate arsenic, which could result in elevated exposures to wetland birds that may be attracted to the site

The period of risk from spills from transportation of hazardous and toxic chemicals would be increased in the proposed action beyond that of the no action alternative.

1-18 3.6.4 Wildlife and Fisheries Resources, Potential Mitigation and Monitoring (page 3-91): If the 8-South partial pit backfill is not conducted, we recommend that water, sediment, and aquatic biota (e.g., food chain organisms) in the pit lake be monitored periodically for at least 10 years following flooding of the pit. Samples should be analyzed for arsenic and mercury at



# Responses to Letter 1

1-13 Potential to emit calculations for each source were originally based on maximum permitted values or ratio-up factors. Estimated potential emissions of Mercury (Hg) from point sources at the proposed mine in tons per year and as a percentage of total Hg emissons from mine sources are listed in the following table:

Potential to Emit

| Source | Potential Hg Emissions (tpy) | Total Hg Emissions (percent) |
|---|---|---|
| Crucible furnace | 0.596 | 28.5 |
| Electrowinning | 0.465 | 22.3 |
| Carbon kiln | 0.166 | 8.0 |
| Mercury retort | 0.851 | 40.7 |
| Other sources | 0.011 | 0.5 |
| Total | 2.09 | 100.0 |

Emissions data were based on factors developed by the Nevada Mining Association and accepted by the NDEP Bureau of Air Quality. Direct mitigation is not well understood, and control technologies are not proven in terms of effectiveness. Actual emissions of Hg would be significantly lower than the potential to emit as calculated from permitted values. Actual operating data shows that not all mercury contained in the material mined at Marigold would become available for air emissions. Aside from fugitive dust emissions, the only place that mercury emissions into air can occur is in the high temperature areas of the process, such as the retort, carbon kiln, carbon stripping, electrowinning, and crucible furnace. Using the year 1998 actual operating data, the total recovery of mercury into solution from mill and heap leach operations at the Marigold Mine was about 4.84 percent. Less than one-fourth of this mercury was then recovered onto the carbon (1.05 percent). At this rate, 402 pounds of Hg would report to solution and 87 pounds of Hg would report to carbon in a typical year. Since mercury loaded on carbon is the only mercury that would be subjected to high temperatures and potential volatilization, the maximum process related (excluding fugitive dust) air emission of mercury for a typical year is 87 pounds (0.044 tpy). The year 1998 is assumed to be a typical year with 2,833,700 tons of leach ore and 367,600 tons of mill ore being processed.

The Marigold plant is equipped with a retort that is specifically designed to remove mercury from electrowinning sludge before the furnace melts thereby lowering actual air emissions. In 1998, 50.5 pounds of mercury collected in the retort, leaving only 36.5 pounds potentially available for air emissions. It is not possible to determine if this mercury actually reported to air emissions or was returned to heap solution through strip solution bleeds. Since the retort is designed to be very efficient, it is suspected that the air emissions were much less than the calculated residual 36.5 pounds. GMMC routinely tests the atmosphere in the vicinity of the high temperature areas of the process for mercury emissions using a Jerome Gold Film Vapor Analyzer. The results show compliance with workplace health standard limits for mercury. Also, routine mercury hygiene samples have shown no elevation of mercury in refinery, lab, and process employee urine samples.

The other source of mercury emissions into air is fugitive dust. Assuming that the mercury content in fugitive dust will be the same as the mercury content in waste/ore it would equal 0.74 mg/kg. This gives an estimated fugitive dust mercury emission of 6 pounds (0.003 tpy).

Projected "Actual" Emissions

| Source | "Actual" Hg Emissions (tpy) | Hg Emissions as Percent of Total (Percent) |
|---|---|---|
| High temperature areas of the process: Crucible furnace, Electrowinning, Carbon Kiin, Mercury Retort | 0.044 | 93.6 |
| Other Sources | 0.003 | 6.4 |
| Total | 0.047 | 100.0 |

Text in Section 3.3.2, Environmental Consequences, has been revised as a result of the comment.

1-14 Text in Section 3.5.1.1, Vegetation, was revised according to the information provided in the comment.

1-15 Once partiai backfill of the 8-South pit bottom is completed, the pit would be seeded with the appropriate seed mixture (page. 2-35; Table 2-6) which includes a mixture of grasses, forbs and shrubs.

1-16 Text in Section 3.6.1.2, Proposed Action, has been revised and text has been added as a result of the comment.

1-17 See response to Comment 1-8.

1-18 See response to Comment 1-8.

# Letter 1 Continued



1-18 a minimum. Bird use of the pit lake should be quantified. This should be followed by the development of an risk assessment to determine risks to wildlife, including migratory birds. If risks are judged to be excessive, the pit should then be promptly backfilled.

1-19 3.7.1 Special Status Species, Affected Environment, Table 3-17 (page 3-93): The correct spelling of the scientific name for Elko rockcress is *Arabis falcifructa*. The correct spelling of the scientific name for sand cholla cactus is *Opuntia pulchella*.

1-20 3.7.1.2 Special Status Species, Affected Environment, Birds (page 3-95): The burrowing owl is incorrectly characterized as an uncommon summer migrant. Burrowing owls are known to breed in the project vicinity. Although the majority of the breeding population in northern Nevada migrates during the winter, this species has been observed throughout Nevada during all months of the year.

1-21 3.7.5 Special Status Species, Residual Adverse Impacts (page 3-100): There would be residual adverse impacts to sage grouse due to potential habitat loss and conversion of shrub-dominated communities to grass-dominated communities.

1-22 3.13.1 Hazardous Materials, Affected Environment (page 3-142): Mercury should be mentioned in the text, as it is found in Table 3-26. Under the subheading Sodium Hydroxide, the accident rate per mile is incorrect, leading to an incorrect number of projected releases.

APPENDICES

1-23 Tables A-3 and A-4: Please provide the units of measurement and indicate what "-" means in front of some numbers. In Table A-4, please indicate the location of the water wells NM-028 and NM-030. The concentrations of some constituents from these two wells are extremely elevated. The significance of these concentrations should be explained at an appropriate point in the text of the DEIS.

We appreciate the opportunity to review the DEIS for this project. If you have any questions, please contact Stanley Wiemeyer at (775) 861-6300 on hazardous materials and environmental contaminants issues and Laura Berglund at (775) 623-1526 on other topics.

Allan R. Pfister
for Robert D. Williams



# Responses to Letter 1

1-19 The scientific names of plants listed in Table 3-18 have been corrected according to the information provided in the comment.

1-20 Text regarding the burrowing owl has been revised and added to Section 3.7.1.2, Birds, based on the information provided in the comment.

1-21 Based on the comment, text regarding potential impacts to sage grouse was added to Section 3.7.2.1, Proposed Action, and 3.7.5, Residual Impacts.

1-22 Mercury has been deleted from Table 3-27 since GMMC does not propose to use mercury during project operations. The accident rate per mile for sodium hydroxide has been corrected to 0.00000012, which lowers the projected number of releases during the project from 0.0013 to 0.0004.

1-23 The symbol "-" has been replaced with "<" in Table B-6 to indicate that measurements were less than the detection limits. The following note has been added to Tables B-2, B-3, and B-6 to indicate the unit of measure for the various constituents, "pH is measured in standard units; all other constituents are measured in mg/l." The locations of NM028 and NM030 monitoring wells are located in the 8-South Pit area. The northing and easting for each well is provided in Table B-6 and the locations of these wells can be determined by reviewing Map 3-2. Barium, arsenic, and copper are slightly elevated above background values. All other metallic and non-metallic constituents are within Nevada drinking water quality standards. These constituents are common in the ore from the existing 8-South Pit and it is believed that these wells are screened in mineralized rock.

# Letter 2

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

APR 8 2000

Terry Reed, Field Manager
Winnemucca Field Office
Bureau of Land Management
5100 E. Winnemucca Blvd.
Winnemucca, NV 89445

Dear Mr. Reed:

The U.S. Environmental Protection Agency (EPA) has reviewed the **Draft Environmental Impact Statement (DEIS) for the Marigold Mine Expansion Project, Humboldt County, Nevada**. Our review is conducted pursuant to the National Environmental Policy Act (NEPA), the Council on Environmental Quality's NEPA Implementation Regulations at 40 CFR 1500-1508, and Section 309 of the Clean Air Act.

The DEIS evaluates alternatives for expanding the existing Marigold Mine. Glamis Marigold Mining Company (GMMC) has proposed to expand two existing pits and develop two new pits; expand existing and develop two new waste rock dumps; expand existing and add new heap leach facilities; expand existing and add new tailings facilities; and construct ancillary facilities such as haul roads, ponds, soil stockpiles, and diversion channels. Alternatives include the 8-South Partial Pit Backfill Alternative and the No Action Alternative.

We have rated this DEIS as EO-2 -- Environmental Objections-Insufficient Information (See enclosed "Summary of Rating Definitions and Follow Up Actions"). Our objections are based on the project's potentially significant impacts to water quality and air quality. We believe these impacts should be avoided to the extent possible in order to provide adequate protection for the environment and that aditional mitigation measures are necessary for impacts which are unavoidable. The DEIS also fails to demonstrate compliance with EPA's Guidelines pursuant to Clean Water Act Section 404(b)(1), i.e., the alternatives analysis is too narrow for the stated project purpose and there is insufficient information to determine the practicability of the alternatives evaluated. The Final Environmental Impact Statement (FEIS) should provide additional information regarding impacts to water and air quality, ecological risks, bonding and closure, mitigation measures, and geochemical characterization. Our detailed comments, which focus specifically on these issues, are enclosed.

# Letter 2 Continued



We appreciate the opportunity to review this DEIS. Please send a copy of the FEIS to this address when it is officially filed with our Washington, D.C., office. If you have any questions, please call me at (415) 744-1566, or have your staff call Jeanne Geselbracht at (415) 744-1576.

Sincerely,

Deanna M. Wieman, Deputy Director
Cross-Media Division

003186

Enclosures

cc: Dave Gaskins, NDEP
Nancy Kang, Army Corps of Engineers - Reno
Jolaine Johnson, NDEP

# Letter 2 Continued

**General Comments**

2-1 The DEIS states that the proposed 8-North Pit would only be mined if gold prices are above $400 per ounce. All other pits have reserves that can be economically recovered at less than $400 per ounce. Given that current gold prices are far below $400 per ounce, the FEIS should identify the cost at which GMMC believes the other pits can be economically recovered.

2-2 An alternative that would place waste rock from the 8-North Pit into the proposed 5-North Pit was eliminated from detailed analysis in part because if backfilling the 5-North Pit were required, and the 8-North Pit were never developed, the operator would be in noncompliance for not backfilling the 5-North Pit with material from a non-viable ore body (DEIS, p. 2-46). This reasoning appears flawed, as BLM could easily include a condition in the Plan of Operation (POO) that exempts the operator from backfilling 5-North Pit with 8-North waste rock if the 8-North Pit is never developed. The FEIS should more thoroughly evaluate the logistics, economics, and environmental impacts of partially or completely backfilling the 5-North Pit with 8-North Pit waste rock. The costs and benefits of temporary storage of waste rock on the surface and later backfilling of the 5-North Pit should be discussed.

**Clean Water Act Section 404**

The DEIS (p. 3-30,31) states that 1.3 acres of waters of the U.S. would be disturbed by the Proposed Action and that the project would be authorized under Nationwide Permit 26. Nationwide Permit 26, however, is no longer valid (as of March 7, 2000) and cannot be applied to this project. The new Nationwide Permit 44 for Mining Activities, which was published by the U.S. Army Corps of Engineers (Corps) in the March 9, 2000, Federal Register (65 FR 12818) and will become effective on June 5, 2000, may be appropriate, but limits impacts to waters of the U.S. to 0.5 acre. Therefore, we expect that the proposed work would require an individual Department of the Army permit under Clean Water Act Section 404.

2-3 Section 404 regulates the discharge of dredged or fill material into waters of the United States, including wetlands and other "special aquatic sites." If a permit is required, EPA will review the project for compliance with Federal Guidelines for Specification of Disposal Sites for Dredged or Fill Materials (40 CFR 230), promulgated pursuant to Section 404(b)(1) of the Clean Water Act ("404(b)(1) Guidelines"). The DEIS does not demonstrate compliance with EPA's 404(b)(1) Guidelines. The following comments provide the rationale for our conclusion, **within the context of CWA Section 404:**

Project Purpose - The proposed project's purpose is to mine gold. For the purposes of determining compliance with 40 CFR 230.10(a), EPA Region 9 considers that the term "overall project purpose" means the basic project purpose plus consideration of costs and technical and logistical feasibility. Therefore, the term "overall project purpose" should not include (1) project amenities, (2) a particular return on investment (unless a certain minimum return can be shown to



# Responses to Letter 2

2-1 Text was added to Section 2.2.2.1, Open Pit Development, that provides the gold price needed for development of the 5-North Pit and the existing pits.

2-2 The BLM analyzed placement of waste rock from the 8-North Pit into the proposed 5-North Pit. Section 2.5, Alternatives Considered but Eliminated from Detailed Analysis, provides justification for eliminating this alternative from detailed analysis. This alternative would include increased hauling distance costs, additional disturbance from construction of a new haul road, air quality impacts from haul trucks traveling greater distances and from construction of new haul road and additional costs associated for crossing the Trout Creek diversion. BLM is sensitive to the potential for sequential backfilling of pits. The 8-South Partial Pit Backfill Alternative was analyzed in detail in the EIS. The 8-South Pit is located closer to the 8-North Pit and offers better economic and environmental benefits, such as shorter hauling distance and reduced haul road construction disturbance.

2-3 The sentence, "This is well under ... Nationwide Permit 26." has been deleted as a result of the comment. In addition, text was added to Section 3.1.2.1, Surface Water, regarding the identification of and disturbance acreage estimates for waters of the U.S. present within the project area.

# Letter 2 Continued

render a project impracticable), (3) highest and best use of the land, or (4) certain desired size requirements. EPA Region 9 treats the basic project purpose as the generic function of the activity. Pursuant to 40 CFR 230, any permitted discharge into waters of the U.S. must be the least environmentally damaging practicable alternative available to achieve the project purpose.

2-3

Geographic Scope of the Alternatives Analysis - The geographic scope proposed by the applicant is too narrow for the purposes of the alternatives analysis. In defining the project purpose as mining gold, the analysis should include all areas that would be reasonable to consider in this particular industry. The DEIS only closely analyzes two on-site alternatives besides the No Action Alternative. It appears, however, that other on-site and off-site alternatives may be available that are less environmentally damaging than the Proposed Action. In evaluating on-site alternatives, for example, the FEIS should consider whether waste rock from the 5-North Pit or the other expanding pits could economically be dumped into the 8-South Pit as partial backfill. The environmental consequences of partial backfill of waste rock from these different pits into the 8-South Pit should also be assessed. In evaluating off-site alternatives, the FEIS should include a review of other mining districts and mining properties that GMMC has considered, or should consider, in meeting its Purpose and Need.

2-4

Avoidance, Minimization, and Mitigation - EPA's 404(b)(1) Guidelines are written hierarchically to ensure that efforts are first made to achieve the objective of the CWA to eliminate discharges of pollutants into the nation's waters. Discharges that can be avoided through implementation of a practicable alternative must be avoided. Discharges that cannot be avoided must be minimized to the extent practicable. Compensatory mitigation should only be used to offset unavoidable impacts that remain.

2-5

Determination of Practicability - There is insufficient information in the draft alternatives analysis to determine practicability of the alternatives. The 404(b)(1) Guidelines define practicable as available and capable of being done taking into account cost, existing technology, and logistics [40 CFR 230.10(a)(2)]. For example, in determining practicability, a project alternative that achieves a smaller return on investment than the applicant's preferred alternative may be considered practicable for the purposes of 404 permitting, even though that alternative may not be financially acceptable to a particular applicant. In addition, it is important to note that "sunk costs" associated with one site cannot be assigned to an alternative. In evaluating alternatives under the Guidelines, these "sunk costs" cannot be added to the costs of developing a less damaging design or site.

2-6

Mitigation- If unavoidable fill in waters of the U.S. can be demonstrated, the FEIS should discuss how potential impacts would be minimized and mitigated. This discussion should include: (a) type of mitigation (e.g., conservation easements, habitat creation, etc.); (b) relation of mitigation areas to project site; (c) acreage and habitat type of waters of the U.S. that would be created or restored; (d) water sources to maintain the mitigation area; (e) revegetation plans including the numbers and age of each species to be planted; (f) maintenance and monitoring plans, including performance standards to determine mitigation success; (g) the size and location of mitigation zones; (h) the parties that would be ultimately responsible for the plan's success;

2-7



# Responses to Letter 2

2-4 See response to Comment 2-2. The BLM does not consider this a "reasonable" alternative in the context of the Council of Environmental Quality (CEQ) Regulations 40 CFR 1502.14(a). In addition, off-site alternatives were not considered "reasonable" due to the location of the ore body, land status, and claim status of properties located outside of the plan area.

2-5 Comment noted.

2-6 Comment noted.

2-7 See response to Comment 2-3.

# Letter 2 Continued

2-7 and (i) contingency plans that would be enacted if the original plan fails. Mitigation should be implemented in advance of the impacts to avoid habitat losses due to the lag time between the occurrence of the impact and successful mitigation.

2-8 In conclusion, a much more detailed analysis is required in order to determine compliance under EPA's 404(b)(1) Guidelines. This includes, but is not limited to, an increase in the geographic scope of the alternatives; a more thorough assessment of the direct and indirect impacts to the environment for each of the alternatives; comparisons of the costs and profits associated with ongoing gold operations; comparisons of costs and profits associated with the alternatives proposed in the DEIS; and mitigation measures that would be used to offset unavoidable impacts.

**Water Quality**

2-9 The 8-South Partial Backfill Alternative is BLM's preferred alternative if gold prices rise above $400 per ounce. It appears to be less environmentally damaging from the standpoint of disturbing fewer acres and obviating the need for the lower reach of the Trout Creek diversion.

2-10 According to the DEIS (p. 3-31), however, rain water infiltrating through the waste rock backfilled into the pit could potentially create seepage to groundwater with elevated levels of arsenic, mercury, and molybdenum. The FEIS should assess the potential for partial backfilling to cause degradation of groundwater quality below the pit and identify waste rock management measures that would be used to prevent such problems.

2-11 A shallow pit lake could form in the 8-South Pit 30 years after closure; and mercury and arsenic concentrations could be high, based on the MWMP. The DEIS, however, does not include an ecological risk assessment for this pit lake which, because of its shallow depth and possible seasonality, may be conducive to the development of wetland habitat. The FEIS should include an ecological risk assessment for this pit lake. Should the risk assessment indicate potential risks to wildlife, the FEIS should discuss means, other than backfilling from the 8-North Pit, of preventing these risks and identify the bond amount that would be required for this element of the POO. It is our understanding that BLM can update the bond amounts for any part of the mine at any time. We recommend that the new information made available through this environmental analysis be used to determine potential mitigation measures and associated bond amounts for ensuring against impacts to wildlife or groundwater. The FEIS should discuss whether waste rock from other pits could be placed into the 8-South Pit if the ecological risk of leaving it open would be unacceptable.

2-12 According to the DEIS (p. 2-17), "[m]inor leakage of pregnant solution has been reported from an existing pregnant solution pond that would be used during the operation phase of the Proposed Action; this leakage has been contained to prevent off-site contamination." The FEIS should indicate how much leakage is occurring, how it is being contained, how much on-site contamination has occurred, and whether the pond liner has been repaired. If the liner has not yet been repaired, the FEIS should indicate when it will be repaired prior to beginning the proposed action.



# Responses to Letter 2

2-8 See responses to Comments 2-2 and 2-4. Costs associated with the various alternatives have been estimated according to the development of specific deposits (i.e., the 8-North Pit would not be developed unless gold was over $400 per ounce). Mitigation measures would be developed and described in the Final Record of Decision to offset any unavoidable adverse impacts.

2-9 See response to Comment 1-1.

2-10 The 8-South Partial Pit Backfill Alternative would involve backfilling only with Edna and Havallah formation rocks originating from the 8-North pit. These have been tested via column leach tests (Appendix B, Table B-7) and shown to be non-acid generating and not likely to leach metals or non-metals to groundwater. Therefore, no impacts to groundwater quality are expected under this alternative.

2-11 See response to Comment 1-8.

2-12 Some of the text in the 4th paragraph in Section 2.2.5.2, Solution Ponds/Collection System, was deleted as a result of the comment. In addition, text regarding the solution remediation activities completed to correct minor leakage associated with one of the existing pregnant solution ponds was incorporated into Section 2.2.5.2, Solution Ponds/Collection System.

# Letter 2 Continued

2-13 Based on the MWMP, waste rock seepage would be elevated in mercury, arsenic, and molybdenum; and East Hill Pit waste rock seepage could be elevated in TDS, chloride, and sulfate as well (DEIS, p. 3-28). The DEIS states that waste rock would be 1,000 feet away from the Cottonwood Creek diversion and 150 feet away from the Trout Creek diversion. Contrary to the assertions in the DEIS that the creeks would not be affected by waste rock seepage, we believe the waste rock is sufficiently close to these diversions for them to be potentially affected, especially during storm events. The FEIS should discuss mitigation measures that would be used to prevent elevated levels of contaminants from reaching these stream diversions, particularly Trout Creek.

2-14 The DEIS (p. 3-90) states that GMMC has committed not to mine the proposed 8-North Pit to a level that would intercept groundwater. The proposed action would facilitate future deeper excavation. The FEIS should discuss whether there is mineral potential below this level and whether future POO amendments could revise this commitment. If so, the FEIS should evaluate the potential environmental impacts of future mining below the water table in the 8-North Pit.

**Bonding and Reclamation**

2-15 We were unable to find any information in the DEIS on the bond amounts for the current and proposed operations at Marigold Mine. The re-opening of the POO should include a reassessment of the adequacy of the financial assurances. The FEIS should identify the bond amounts for each closure and reclamation activity at all of the Marigold Mine facilities by the end of the project. EPA is aware of several mines that are closing in Nevada which will need long-term operations and maintenance for treatment and/or disposal of water from heap leach pads, tailings, or other mine facilities. The FEIS should also discuss whether long-term operations and maintenance may be necessary *after* closure of the Marigold Mine facilities, and indicate the bond amounts for these as well. We do not believe it is reasonable to delay setting bond amounts for long-term operations until two years before closure. EPA strongly recommends that BLM require establishment of funds to cover all potential long-term operations and maintenance activities at the time the POO is issued, while the company still has a strong interest in the property.

Furthermore, the financial assurance necessary to fund post-closure activities will need to be kept current as conditions change at the mine. BLM should ensure that the form of the financial assurance does not depend on the continued financial health of the mining company or its parent corporation. We recommend that a financial trust be created to support long-term operations and maintenance.

In addition to determining the actual cost of reclamation, the bond calculation should consider the extra expense of taking over reclamation at a critical time during operations. Typically, bonds are calculated assuming an orderly closure at the end of mine life. It can be much more expensive to take over reclamation and other environmental protection activities in the middle of active operations, such as when the water balance is high and surplus water must be treated, or



# Responses to Letter 2

2-13 It is unlikely that seepage would occur from the East Hill Waste Rock area. There has been no seepage observed in over 10 years of mine operation at the Marigold Mine. Berms would be constructed around the proposed waste rock dumps to prevent any seepage that may occur from reaching surface water features. Text in Section 2.2.10, Storm Water Control, has been revised accordingly.

2-14 Text regarding the potential for future development of the 8-North Pit has been added to Section 2.6.2, Reasonably Foreseeable Future Actions. A separate NEPA analysis would be completed if GMMC proposed to deepen and expand the 8-North Pit.

2-15 The BLM would reassess adequacy of bond amounts and financial instruments prior to implementing any Plan of Operations approval. Bond cost evaluation would be assessed using guidance from the Nevada BLM Bonding process, dated September 9, 2000. In addition to evaluating bond cost estimates for the proposed new facilities and rinsing costs for all heap leach pads, the new guidance would include bonding for contingency costs should "premature cessation or abandonment of the operation occur."

# Letter 2 Continued

2-15 when environmental or reclamation measures have not been successful in controlling pollution and must be redone.

2-16 The DEIS (p. 2-35) states that closure of the heap leach facilities would require treatment of the spent heaps to neutralize the weak acid dissociable (WAD) cyanide and lower the pH. The DEIS, however, does not address other contaminants in the heap that could be released after closure and seep into groundwater. For example, the leached ore subjected to Nevada's meteoric water mobility procedure was found to have elevated levels of arsenic and mercury. EPA plans to propose a new drinking water standard for arsenic this spring which would be significantly lower than the current standard. The FEIS should identify the standards for all parameters that the rinsate would have to meet under the three methods before the heap could be closed or before leachate or drain down solutions could be land applied in a constructed leach field. EPA strongly recommends against any degradation of groundwater quality. The FEIS should summarize Nevada BLM's closure policy, which we understand is due to be published soon, in the context of what would be required for this mine at closure.

2-17 The FEIS should also project how long it could take for metals, salts, pH, and total dissolved solids to be reduced to meet drinking water standards under each of the three closure scenarios discussed in the DEIS (pp. 3-35, 36). A reasonable time estimate (or range) is necessary to determine an adequate bond amount for this element of mine closure.

2-18 The DEIS (pp. 2-36, 37) states that if tailings do not meet regulatory requirements (based on MWMP and TCLP tests), an alternative closure plan would be developed with NDEP. The FEIS should describe the regulatory requirements that would apply to tailings and tailings effluent and discuss possible closure scenarios NDEP would allow should the tailings fail to meet these requirements.

2-19 The FEIS should indicate how many years effluent would drain from the tailings at the end of operations and how effluent would be evaporated after vegetation is established on the reclaimed surface.

**Air Quality**

Criteria Pollutants

2-20 Table 3-12 in the DEIS provides potential to emit for criteria pollutants in tons per year. There is no indication, however, how much of these potential emissions would be prevented through mitigation measures for each source. In addition, the DEIS (p. 3-61) indicates PM10 emissions

2-21 monitored in 1991 and 1992, but does not estimate emissions under the proposed project. The FEIS should provide these estimates.

Hazardous Air Pollutants



# Responses to Letter 2

2-16 The closure of all heap leach facilities would meet standards as required by the water pollution control permit issued by the NDEP, Regulation Branch. In addition, heap leach closure, stabilization, and reclamation would be subject to the "Nevada Bureau of Land Management's Guidance for Hardrock Mining Reclamation/Closure Activities – Management of Heap Leach Effluents, per BLM Instruction Memorandum #NV-2000-066 (see Appendix A). Text has been added to Section 2.2.19.8, Facility Reclamation, which describes the variables that would be considered in the selection of the heap closure method.

2-17 The method of heap leach closure is uncertain at this time. The final selection of the leach pad reclamation method would be dependent on several variables, including rinseate quality and residual draindown quality and quantity. Once these variables have been determined, a final closure method would be selected, analyzed, and disclosed through the NEPA process.

2-18 If the tailings do not meet the regulatory requirements of the TCLP and MWMP tests, an alternative closure plan would be developed by GMMC, NDEP, and the BLM. The exact nature of this closure plan cannot be determined at this time since it would depend on the test results at closure. The closure plan would meet State requirements in effect at the time of closure and would be subject to the NEPA process. Implementation of the closure plan would protect the groundwaters of the State, as required by State law.

2-19 The draindown time of a tailings impoundment varies according to the design of the facility. The NDEP would supervise and regulate the monitoring and remediation of seepage from the tailings until seepage ceases. This process may take from 10 to 20 years after mining has been completed. Once vegetation has become established on the reclaimed tailings surface, vegetation would facilitate the drying of the tailings via evapotranspiration.

2-20 The potential to emit values listed in the DEIS included all permitted and insignificant point source emissions. If emission controls were specified in the current Marigold Mine permits, the control efficiency was taken into account.

2-21 Potential to emit $PM_{10}$ value (34.46 tpy) from point sources is provided in the 8$^{th}$ paragraph in Section 3.3.2.1, Proposed Action.

# Letter 2 Continued

2-22 The DEIS (p. 3-60) indicates that the mine would emit approximately 2.09 tons per year (4,180 pounds/year) of mercury, and 9.6 tons per year of all hazardous air pollutants (HAPs) combined. The FEIS should identify the other HAPs, identify all sources of HAPs at the mine, and discuss how all HAPs would be controlled to reduce their emissions as much as possible.

Mercury is a persistent bioaccumulative toxic substance that has been receiving increased attention over the past three years. EPA is becoming increasingly concerned about even small releases of mercury to the atmosphere. Pristine lakes in Wisconsin and remote areas of the Florida Everglades are finding mercury levels in fish above Federal standards for fish consumption. Studies have revealed this mercury is from atmospheric deposition from mercury emissions that are thousands of miles away. EPA now considers mercury air emissions over ten pounds as a significant enough concern that, starting this year, such emissions must be reported by a mining company in its annual Toxic Release Inventory submitted to EPA.

2-23 Recent 1998 Toxic Release Inventory information submitted by Nevada gold heap leach mining companies has revealed that these mines can be significant sources of mercury point source air emissions from autoclaves, roasters, stripping units, electrowinning units, retorts, refining furnaces, and carbon regeneration kilns. One facility had a total of over 9,400 pounds of mercury air emissions while another had over 2,200 pounds.

EPA has not yet developed mercury emission standards for mines, so there are no air permit limitations at present. However, it is important for a NEPA document for a heap leach gold mining operation to disclose potentially harmful air emissions whether they are regulated or not. Since EPA and others have only recently become aware of how mercury is transported through the atmosphere and how much mercury is emitted from gold heap leach mines in Nevada, it is understandable that previous gold heap leach facility EISs have not highlighted mercury emissions. We commend BLM for quantifying in the Marigold DEIS estimated mercury releases.

2-24 However, given the current levels of concern about mercury emissions to the atmosphere, it is important that the FEIS and future gold heap leach facility EISs contain a much more complete description of the existing and future sources of mercury emissions to the atmosphere. The following changes should be made to the FEIS:

a. Table 1.1 "Marigold Mine Existing and Approved Facilities" should include ore processing as a "mine component" and list major processing equipment, including any autoclave or roaster, if they are present.

2-25 b. Table 1.1 "Marigold Mine Existing and Approved Facilities" should include pregnant solution processing as a "mine component" and list major processing equipment, including stripping units, electrowinning units, retorts, refining furnaces, and carbon regeneration kilns, if they are present.



# Responses to Letter 2

2-22 Sources of pollutants are provided in the 8th paragraph in Section 3.3.2.1, Proposed Action. Emissions of any particular HAPs would be controlled by installed baghouses and fugitive dust control measures. In addition, Hg emissions are decreased from mill operations by the mercury retort that is used to recover Hg. The retort is equipped with a scrubber to further reduce Hg emissions to the atmosphere. A list of potential HAPs emissions from point and fugitive sources is shown below:

HAP Potential to Emit[1]

| HAP | Point Source | Fugitive | Total |
|---|---|---|---|
| Antimony | 0.005 | 0.126 | 0.13 |
| Arsenic | 0.015 | 2.606 | 2.62 |
| Beryllium | 0.005 | 0.011 | 0.02 |
| Cadmium | 0.006 | 0.010 | 0.02 |
| Chromium | 0.008 | 1.202 | 1.21 |
| Cobalt | 0.005 | 0.071 | 0.08 |
| Lead | 0.458 | 0.216 | 0.67 |
| Manganese | 0.013 | 1.597 | 1.61 |
| Mercury[2] | 0.044 | 0.003 | 0.047 |
| Nickel | 0.007 | 0.466 | 0.47 |
| Selenium | 0.006 | 0.259 | 0.27 |
| HCN | 0.026 | 0.000 | 0.03 |
| Benzene | 0.010 | 0.006 | 0.02 |
| Dichlorobenzene | 0.000 | 0.000 | 0.00 |
| Formaldehyde | 0.006 | 0.008 | 0.01 |
| Hexane | 0.222 | 0.000 | 0.22 |
| Toluene | 0.121 | 0.003 | 0.12 |
| **Total HAPs (tpy)** | **0.957** | **6.584** | **7.55** |

[1]Potential to emit calculations are based on maximum permitted values or ratio-up factors.
[2]Mercury emissions are based on engineering calculations of processed ore for a typical year.

This table has been added to this section as a result of the comment. See response to Comment 1-13 for a discussion of "potential to emit" compared with "actual" projected emissions of mercury.

2-23 Text regarding mercury emissions has been added to page 3-62 as a result of the comment.

2-24 Ore processing information was added to Table 1-1 as a result of the comment.

2-25 See response to Comment 2-24. The pregnant and barren solution ponds are listed in the heap leach pad section of Table 1-1.

# Letter 2 Continued

2-26 c. Figure 2.4 should show the unit processes after the carbon columns, starting with the stripping circuit. Section 2.2.7 should be expanded to briefly describe these unit processes.

2-27 d. Section 2.218.6, "Air Quality" should be expanded to include a table showing the annual mercury emissions from each processing unit that has mercury. This section should also describe any equipment to condense mercury or treat and capture mercury before it is emitted. It should also note how any condensed or captured mercury is recycled, sold, or disposed.

2-28 e. Section 3.3 "Air Quality" should discuss in general terms national studies showing that atmospheric deposition of mercury is of environmental concern and describe the likely fate and transport of mercury air emissions from the Marigold Mine. This discussion need not be in great detail or based on site specific modeling studies, but merely acknowledge what is known nationally about the problems of atmospheric deposition of mercury and how it is affecting this country's water bodies. A sub-section should be added to specifically quantify existing and future mercury emissions to air.

The FEIS should include the above information so that decision makers are able to know existing and future impacts of mercury emissions from this facility. The absence of air emission permit standards for mercury does not preclude the need to inform decision makers and the public about the quantity and fate of mercury emitted from this facility. Having such information in hand may assist the BLM in determining whether mitigation measures for air mercury emissions should be required of this facility.

For instance, if other mining companies in Nevada have pollution control equipment on unit processes that do not have such controls at the Marigold Mine, BLM could ask that such equipment be installed at the Marigold Mine in order to reduce or mitigate potential adverse environmental impacts from mercury emissions. Pollution prevention opportunities should also be explored pursuant to the Pollution Prevention Act of 1990. Pollution prevention opportunities may include processes such as adding chemicals to the barren leach solution that will selectively keep mercury in the heap leach pile while allowing gold to leach out.

**Biological Resources**

2-29 According to the DEIS (p. 3-99), the Red Rock Adit would be closed to bats. We recommend that GMMC mitigate the loss of this habitat loss nearby.

**Geochemistry**

2-30 The acid-base accounting (ABA) test results should be included in the FEIS to verify the site's geochemical characterization. The DEIS (p. 2-25) states that if ABA tests exceed NDEP and BLM criteria, kinetic tests will be conducted. The FEIS should identify those criteria and, based on the ABA results, indicate whether kinetic tests will be necessary.



# Responses to Letter 2

2-26 Figure 2-5, Carbon Stripping and Gold Recovery Circuit, and text describing the stripping and gold recovery circuit has been added to Section 2.2.7, Process Area, as a result of the comment.

2-27 See response to Comment 1-13.

2-28 "Concern about human impact on the environmental cycling of Mercury (Hg) is widespread... Mass balance studies now show that atmospheric transport and deposition is the dominant pathway delivering Hg to many of the world's lakes and oceans. ... but there is considerable uncertainty about the relative importance of short-range and long-range atmospheric transport." (Watras and Huckabee 1994). From a human and biological perspective, the chemical form of Hg that is of greatest interest is methyl-Hg rather than elemental Hg. "Almost all of the Hg in fish is methylated and fish consumption is the major route to Hg uptake by humans" (Watras and Huckabee 1994). Emissions of Hg from the mill at Marigold are expected to be elemental forms in gaseous state. Fugitive dust emissions also contain Hg in other chemical forms. Also, refer to response to Comment 1-13 for a discussion of actual Hg emissions from the proposed project.

Watras, C. J. and J. W. Huckabee. 1994. Mercury Pollution, Integration and Synthesis. p. 1-19.

2-29 Text was added to Section 2.2.18.5, Wildlife and Livestock Protection, which describes the occasional use of the Red Rock Adit by bats. Environmental protection measures described in this section would be implemented to exclude bats, if present, from the Red Rock Adit. Several abandoned mine shafts and adits occur within the project vicinity and would provide alternative suitable habitat for bats that may be displaced by mining activities. Three bat gates have been installed in the vicinity of the mine to enhance bat habitat previously impacted.

2-30 Tables B-4 and B-5 in Appendix B provide the results of the static acid-base accounting tests conducted on waste rock samples collected from the proposed 8-North and 5-North pit areas. Although some waste rock samples from these proposed pit areas do not meet BLM guidelines for non-acid generating rock, the low levels of pyritic sulfur in the rocks and the paste pH values of 7.0 or higher

# Letter 2 Continued

2-31 According to the DEIS (p. 3-4), the 8-North Pit has the potential for acid generation if the sulfide content of the waste rock should rise due to mining of higher sulfide ore. The geochemistry of the waste rock, spent ore, and pit walls is relevant to potential long-term impacts of the proposed project. The FEIS should present more detailed information on the fate of the sulfides and neutralizing material in waste rock, spent ore, and pit after closure, and how they would be handled during operations and closure. The FEIS should include the Sulfide Waste Management Plan as an appendix or summarize the plan in the body of the document.



# Responses to Letter 2

2-31 See response to Comment 2-30. Key elements of the Sulfide Waste Management Plan are provided in Section 2.2.18.2, Waste Rock Characterization.

# Letter 2 Continued

## SUMMARY OF EPA RATING DEFINITIONS

This rating system was developed as a means to summarize EPA's level of concern with a proposed action. The ratings are a combination of alphabetical categories for evaluation of the environmental impacts of the proposal and numerical categories for evaluation of the adequacy of the EIS.

### ENVIRONMENTAL IMPACT OF THE ACTION

***"LO" (Lack of Objections)***

The EPA review has not identified any potential environmental impacts requiring substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

***"EC" (Environmental Concerns)***

The EPA review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact. EPA would like to work with the lead agency to reduce these impacts.

***"EO" (Environmental Objections)***

The EPA review has identified significant environmental impacts that must be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

***"EU" (Environmentally Unsatisfactory)***

The EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potentially unsatisfactory impacts are not corrected at the final EIS stage, this proposal will be recommended for referral to the CEQ.

### ADEQUACY OF THE IMPACT STATEMENT

***Category 1" (Adequate)***

EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis or data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

***"Category 2" (Insufficient Information)***

The draft EIS does not contain sufficient information for EPA to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analysed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyses, or discussion should be included in the final EIS.

***"Category 3" (Inadequate)***

EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analysed in the draft EIS, which should be analysed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the NEPA and/or Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.

*From EPA Manual 1640, "Policy and Procedures for the Review of Federal Actions Impacting the Environment."

# Letter 3

KENNY C. GUINN
*Governor*

**STATE OF NEVADA**

JOHN P. COMEAUX
*Director*

**DEPARTMENT OF ADMINISTRATION**
**209 E. Musser Street, Room 200**
**Carson City, Nevada 89701-4298**
**Fax (775) 684-0260**
**(775) 684-0222**

April 4, 2000

Mr. Gerald Moritz, EIS Project Manager
Bureau of Land Management
Winnemucca Field Office
5100 E. Winnemucca Boulevard
Winnemucca NV 89445

Re: SAI NV # E2000-095

Project: DEIS for Glamis Marigold Mining Company's Marigold Mine

Dear Mr. Moritz:

Enclosed are the comments from the Nevada Division of Water Resources and Bureau of Health Protection Services concerning the above referenced report. These comments constitute the State Clearinghouse review of this proposal as per Executive Order 12372. Please address these comments or concerns in your final decision. If you have questions, please contact me at 684-0209.

Sincerely,

Heather K. Elliott

Heather K. Elliott
Nevada State Clearinghouse/SPOC

# Letter 3 Continued

# Responses to Letter 3

NEVADA STATE CLEARINGHOUSE
Department of Administration
Budget and Planning Division
209 East Musser Street., Room 200
Carson City, Nevada 89701-4298
(775) 684-0209
fax (775) 684-0280

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MAR 15 2000
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DIRECTOR'S OFFICE

DATE: February 11, 2000

| | | |
|---|---|---|
| Governor's Office | Legislative Counsel Bureau | Conservation-Natural Resources |
| Agency for Nuclear Projects | Information Technology | Director's Office |
| Agriculture | Emp. Training & Rehab Research Div. | State Lands |
| Business & Industry | PUC | Environmental Protection |
| Energy | Transportation | Forestry |
| Minerals | UNR Bureau of Mines | Wildlife |
| Economic Development | UNR Library | Region 1 |
| Tourism | UNLV Library | Region 2 |
| Fire Marshal | Historic Preservation | Region 3 |
| Human Resources | Emergency Management | Conservation Districts |
| Aging Services | Office of the Attorney General | State Parks |
| Health Division | Washington Office | Water Resources |
| Indian Commission | Nevada Assoc. of Counties | Water Planning |
| Colorado River Commission | Nevada League of Cities | Natural Heritage |
| | | Wild Horse Commission |

Nevada SAI # E2000-095
Project: DEIS for the Marigold Mine Expansion Project
NOTE: BLM indicates it has sent directly to: GOV, NDOM, NDOT, SHPO, LANDS, NDEP, WILD #2 & NDWR.
If you need another copy, please contact the Clearinghouse.

CLEARINGHOUSE NOTES:
Enclosed, for your review and comment, is a copy of the above mentioned project. Please evaluate it with respect to its effect on your plans and programs the importance of its contribution to state and/or local areawide goals and objectives; and its accord with any applicable laws, orders or regulations with which you are familiar.

Please submit your comments no later than **April 3, 2000**. Use the space below for short comments. If significant comments are provided, please use agency letterhead and include the Nevada SAI number and comment due date for our reference. Questions? Heather Elliott, 684-0209.

THIS SECTION TO BE COMPLETED BY REVIEW AGENCY:

___No comment on this project
___Proposal supported as written
_X_Additional information below
___Conference desired (See below)
___Conditional support (See below)
___Disapproval (Explain below)

**AGENCY COMMENTS:**

Water rights and current level of permit approvals for the various dams and impoundments at the mine site are correctly outlined. The operator has cooperated well with personnel from this office and the State Engineer is confident they will continue to do so.

3-1 An error was noted on page 3-7, section 3.1.1.2. The project area lies in Clovers Area, basin 64, which encompasses a reach of the Humboldt River and it's tributaries. The State Engineer is also concerned about flood routing in the diverted washes and creeks after closure of the mine. If any features (pits, leach pads, tailings facilities) are in the bottom of the drainages, very substantial diversion structures will be required to avoid failure of waste encapsulation or flooding of the abandoned pits. Additionally, periodic maintenance will be required in perpetuity for any structures or diversions that are built to any standard less than that required for an extreme precipitation event (PMF).

MICHAEL J. ANDERSON, P.E. clear clear.doc — NDWR — WATER RESOURCES — 3/13/2000 (Date)

3-1 Text in the 2nd paragraph in Section 3.1.1.2, Surface Water, has been revised to indicate the project area lies in the Clovers Area (Nevada Hydrographic Basin 64). As stated in Section 2.2.19.8, Facility Reclamation, GMMC will submit engineered design reports to BLM for review and concurrence, prior to initiating construction of the drainage diversions. Based on these reports, the BLM and NDEP would determine the appropriate bond amount, taking into consideration long-term monitoring costs, channel maintenance expense, and including sufficient funding for the complete reconstruction of the diversions.

# Letter 3 Continued

RECEIVED
MAR 2 2 2000
DEPARTMENT OF ADMINISTRATION
DIRECTOR'S OFFICE

NEVADA STATE CLEARINGHOUSE
Department of Administration
Budget and Planning Division
209 East Musser Street, Room 200
Carson City, Nevada 89701-4298
(775) 684-0209
fax (775) 684-0260

DATE: February 11, 2000

| | | |
|---|---|---|
| [ ] Governor's Office | Legislative Counsel Bureau | Conservation-Natural Resources |
| Agency for Nuclear Projects | Information Technology | [ ] Director's Office |
| [ ] Agriculture | Emp. Training & Rehab Research Div. | [ ] State Lands |
| Business & Industry | [ ] PUC | [ ] Environmental Protection |
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| [ ] Health Division | Washington Office | [ ] Water Resources |
| Indian Commission | Nevada Assoc. of Counties | Water Planning |
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| | | Wild Horse Commission |

Nevada SAI # E2000-095
Project: DEIS for the Marigold Mine Expansion Project
NOTE: BLM indicates it has sent directly to: GOV, NDOM, NDOT, SHPO, LANDS, NDEP, WILD #2 & NDWR. If you need another copy, please contact the Clearinghouse.

[redacted]

CLEARINGHOUSE NOTES:
Enclosed, for your review and comment, is a copy of the above mentioned project. Please evaluate it with respect to its effect on your plans and programs the importance of its contribution to state and/or local areawide goals and objectives; and its accord with any applicable laws, orders or regulations with which you are familiar.

Please submit your comments no later than **April 3, 2000**. Use the space below for short comments. If significant comments are provided, please use agency letterhead and include the Nevada SAI number and comment due date for our reference. Questions? Heather Elliott, 684-0209.

THIS SECTION TO BE COMPLETED BY REVIEW AGENCY:

- ✓ No comment on this project
- ___ Proposal supported as written
- ___ Additional information below
- ___ Conference desired (See below)
- ___ Conditional support (See below)
- ___ Disapproval (Explain below)

AGENCY COMMENTS:

Signature s:\ahardat\clear\clear.doc

BMI

Agency

3-20-00

Date

## Letter 3 Continued

## Responses to Letter 3

# Letter 4

In Reply Refer To:
Mail Stop 423

March 31, 2000

MEMORANDUM

To: Gerald Mority, EIS Project Manager
Bureau of Land Management, Winnemucca Field Office

From: James F. Devine SIGNED
Senior Advisor for Science Applications

Subject: Draft Environmental Impact Statement for the Marigold Mine Expansion Project

As requested by the Department of the Interior, Bureau of Land Management, in their correspondence of February 11, 2000, the U.S. Geological Survey has reviewed the subject Draft Environmental Impact Statement (EIS) and offers the following observations and comments.

**GENERAL COMMENTS:**

4-1 The Regional Geological Setting (Section 3.2.1.1) and the Geologic Setting of the Marigold Mine Area (Section 3.2.1.8) of the Draft EIS contain numerous inaccuracies because the maps and discussion are based solely on the geology by Roberts (1964). More recent publications and maps of the mine area (see References) have added data and changed interpretations, which revise and update the work of Roberts. Inclusion of the more recent information should be included for completeness of geologic interpretation.

**SPECIFIC COMMENTS:**

**Page 3-23, Section 3.1.1.2; Tailing Impoundment Hydrology and Lone Tree Mine Dewatering and Water Level Declines at the Marigold Mine:**

4-2 The study shows that the existing tailings impoundment has been seeping tailings fluid into the vadose zone on the northern side of the facility. The seepage is slightly more acidic than the alluvial groundwater, and also contains elevated concentrations of total dissolved solids (TDS) and chlorides. Construction of an additional tailings pond is being considered for use when the existing impoundment is filled. Noting the general direction of groundwater flow from the site toward the Humboldt River, attention should also be given to the possibility of similar seepage from the impoundment. This should include consideration of establishing appropriate

# Responses to Letter 4

4-1 Although the references included in the comment may provide more recent interpretations of the geology of the project area, the information provided in Roberts (1964), and other sources cited in text sufficiently describe the regional and site-specific geologic settings.

4-2 The impoundment would be lined with a compacted clay layer or a synthetic liner. Seepage from this facility is unlikely. Monitor wells would be installed downgradient of the tailings impoundment according to NDEP guidelines. The State of Nevada regulates tailings facilities and would establish the requirements for monitoring seepage from the new tailings impoundment.

# Letter 4 Continued

4-2 monitoring wells in the groundwater downstream gradient of the new impoundment in addition to remedial actions as appropriate.

**Page 3-34, Section 3.2.1.1; Regional Geological Setting:**

4-3 The orogenic sequence, as described, is confusing. Orogenic events include the Antler, the late Paleozoic Humboldt, the Permian to Triassic Golconda, Jurassic and Cretaceous thrusting and intrusion, and the Teritary extension. The Golconda is considered Permian to Triassic, not Mesozoic, although it may have moved in the Jurassic. Using Permian to Triassic or Permian-Mesozoic for Golconda is a more accurate description.

4-4 The conclusion in the last sentence of the last paragraph of this section is incorrect. Establishment of the origin of the ore is difficult, but much of the ore is probably Eocene to Oligocene in age.

**Pages 3-34 through 3-42, Section 3.2.1.2; Stratigraphy:**

4-5 The Regional Geologic Map (page 3-40, Map 3-6) and the discussion in the Stratigraphy text and tables are not totally correct. The more recent modified geologic map on page 456 of Doebrich and Theodore (1996) would be more accurate. If the Roberts map (Map 3-6) is used, it needs to be standardized; for example, the use of K, not C, for Cretaceous and the correct symbols for Paleozoic rocks.

4-6 Some of the updates of Roberts map (1964) that are needed in the Battle Mountain area stratigraphic column (page 3-37 to 3-38, Table 3.7) include identification of the Harmony as Cambrian, not Mississippian, identification of Tertiary as well as Late Cretaceous intrusions, inclusion of the Pumpernickel in the Havallah, and the designation of a Permian, Pennsylvanian, Mississippian age to the Havallah. Also, the Scott Canyon Formation is Devonian, not Mississippian.

4-7 The Lower and Upper Plate Sequence sections (page 3-39) also need to be updated. Differentiate the Late Cretaceous and Tertiary intrusions and, where appropriate, the related mineralization.

4-8 In the last paragraph of this section (page 3-42), it is stated that ore formed 10 to 25 million years ago during Basin and Range uplift. The age of most gold mineralization at Battle Mountain is Eocene to Oligocene. The age of deposits to the north, such as Marigold and Lone Tree, is controversial but seems to be the upper portions of Eocene to Oligocene gold systems exposed at Battle Mountain.

**Page 3-42, Section 3.2.1.3; Structure:**

This section also needs to be revised according to new research.

# Responses to Letter 4

4-3 See response to Comment 4-1.

4-4 Comment noted.

4-5 See response to Comment 4-1.

4-6 See response to Comment 4-1.

4-7 See response to Comment 4-1.

4-8 Comment noted. The age of gold mineralization in northern Nevada is uncertain and subject to debate due to the lack of accurate isotopic dating.

# Letter 4 Continued

**Page 3-43, Section 3.2.1.7; Seismicity:**

4-9 The statement, "The Marigold Mine is not located in an area of known seismicity...," is misleading. The state of Nevada is considered one of the most seismically active of the 50 states, and most of the recent seismicity has been concentrated in the Nevada seismic belt, which is located southwest of the Marigold Mine (page 3-44, Map 3-7).

**Page 3-44, Map 3-7; Quaternary Faults in Nevada:**

4-10 The reference for this map (Dohrenwend et al. 1995) is incorrect and incomplete here and in the Reference section. Dohrenwend et al.,1996, (see below) is probably the proper reference and should be used. In addition, young faults cutting Late Tertiary and (or) Quaternary volcanic rocks described in Dohrenwend et al. are missing from Map 3-7. These faults should be included as "Undifferentiated and Undated Faults".

**Page 3-45, Map 3-8; Seismic Events:**

4-11 A reference in the Reference Section and a date for the source of information on seismic events need to be included. The seismic events compiled by the University of Nevada, Reno Seismological laboratory, the U. S. Geological Survey, and the California Institute of Technology (http://www.seismo.unr.edu/htdocs/doctograp/nv_eq.html) are dissimilar in some respects from Map 3-8. Rectification of the differences would be helpful.

**Page 3-46, Section 3.2.1.7; Seismicity, last paragraph:**

The term "maximum credible earthquake" needs to be defined. Also, it would be helpful when using probabilistic data for describing earthquake hazards, that the meaning of the data should be included. For example, the hazard could be given in terms of the probability (%) that a certain peak ground acceleration (PGA, in % acceleration of gravity g) will be exceeded within the next 50 years. For the vicinity of the Marigold Mine (approximately latitude 40.75°, longitude 117.125°), there is 10% probability that PGA will exceed 17% g in 50 years (USGS National Seismic Hazard Mapping Project, http://geohazards.cr.usgs.gov/eq), 5% probability that it will exceed 24% g, and 2% probability that it will exceed 35% g.

4-12 Given a 2% probability that the peak ground acceleration would exceed 35% acceleration of gravity, the Draft EIS statement that the tailings impoundments could withstand 48% acceleration of gravity implies that damage to these facilities is not likely. However, no information is given to evaluate the impact and likelihood of damage to other structures at the mine.

The statement that the largest recorded earthquake within 100 miles of the site produced a ground acceleration of 9% of the acceleration of gravity is not adequately explained. The largest earthquake is the Pleasant Valley 7.8 magnitude earthquake of 1915 (Map 3-8; http://wwwneic.cr.usgs.gov/neis/states/nevada/nevada.html), located about 28 miles southwest of the site. The 9% acceleration of gravity value given here is questionable because damage to

# Responses to Letter 4

4-9 The justification for the statement provided in text was based on the fact that the mine is not located within the Nevada seismic belt and has not been an area of active earthquakes.

4-10 Comment noted. The reference used in text was an U.S. Geological Survey open file report dated 1995 and was considered adequate for the analysis.

4-11 See response to Comment 4-10.

4-12 Thank you for the information. In addition, see response to Comment 4-1.

# Letter 4 Continued

4-12 buildings was reported within 40 miles of the epicenter of this earthquake, and the general threshold for damage to older buildings is >10% acceleration of gravity (http://geohazards.cr.usgs.gov/eq/html/faq.shtml).

**Page 3-46, Section 3.2.1.8; Geological Setting Of The Marigold Mine Area, Mineralization and Pit Geology:**

4-13 Add "thallium" to the last sentence, as it is also an important pathfinder element at Marigold.

**Page 3-47, Map 3-9, Site Geologic Map:**

4-14 A more recent site map of the geology of the Marigold Mine area (modified after Roberts, 1964) is on page 868 of Graney and McGibbon (1991). If substitutions are made to either of the geologic maps in the Draft EIS, unit symbols on Map 3-9 need to correspond to the symbols used on the regional map (page 3-40, Map 3-6).

**REFERENCES**


Pre-publication colored copies of the geologic maps of the Battle Mountain area can be obtained from T. G. Theodore, USGS, Menlo Park, California (Phone number 650-329-5365).

Doebrich, J.L., 1992, Preliminary geologic map of the Antler Peak 7.5-minute quadrangle, Lander County, Nevada: U.S. Geological Survey Open-File Report 92-398, scale 1:24,000.

Doebrich, J.L., 1994, Preliminary geologic map of the Galena Canyon quadrangle, Lander County, Nevada: U.S. Geological Survey Open-File Report 94-664, scale 1:24,000.

Doebrich, J.L., 1995, Geology and mineral deposits of the Antler Peak 7.5-minute quadrangle, Lander County, Nevada: Nevada Bureau of Mines and Geology Bulletin 109, 44 p., 2 plates, scale 1:24,000.

Doebrich, J.L., and Theodore, T.G., 1996, Geologic history of the Battle Mountain mining district, Nevada, and regional controls on the distribution of mineral systems, *in* Coyner, A.R., and Fahey, P.L., eds., Geology and Ore Deposits of the American Cordillera: Geological Society of Nevada Symposium Proceedings, Reno/Sparks, Nevada, April 1995, p. 453-483.

Dohrenwend, J. C., Schell, B. A., Menges, C. M., Moring, B. C., and McKittrick, M. A., 1996, Reconnaissance photographic map of young (Quaternary and late Tertiary) faults: Nevada Bureau of Mines and Geology Open-File Report 96-2, p. 9-1 through 9-12, 1 plate, scale 1:1,000,000.

Graney, J.R., and McGibbon, D.H., 1991, Geological setting and controls on gold mineralization


# Responses to Letter 4

4-13 Thank you for the information. Text has been revised according to the comment.

4-14 Thank you for the information. See response to Comment 4-1. The geology map for the mine site was provided by GMMC and is considered sufficient for the EIS.

# Letter 4 Continued

in the Marigold Mine area, Nevada, *in* Raines, G.L., Lisle, R.E., Schafer, R.W., and Wildinson, W.H., eds., Geology and Ore Deposits of the Great Basin, Symposium Proceedings: Reno, Nevada, Geological Society of Nevada, p. 865-874.

McGibbon, D.H. and Wallace, A.B., 1998-in press, Geology of the Marigold Mine area: *in* Theodore, T. G., 1998-*in press*, Geology of pluton-related gold mineralization at Battle Mountain, Nevada: Tucson, Arizona, University of Arizona and U. S. Geological Survey Center for Mineral Resources, Monograph 2.

Murchey, and a section on Helicoprion sp. *in* Pennsylvanian and Permian Antler Peak Limestone, Sander County, Nevada, by R.A. Hanger, E.E. Strong, and R.T. Ashinhurst: U.S. Geological Survey Open-File Report 94-436, scale 1:24,0

Peters, S.G., Nash, J.T., John, D.A., Spanski, G.T., King, H.S., Connors, K.A., Moring, B.C., Doebrich, J.L., McGuire, D.J., Albino, G.V., Dunn, V.C., Theodore, T.G., and Ludington, Steve, 1996, Metallic mineral resources in the U.S. Bureau of Land Management's Winnemucca District and Surprise Resource Area, northwest Nevada and northeast California: U.S. Geological Survey Open-File Report 96-712, 147 p, 11 plates.

Theodore, T.G., 1991, Preliminary geologic map of the North Peak quadrangle, Humboldt and Lander Counties, Nevada: U.S. Geological Survey Open-File Report 91-429, scale 1:24,000.

Theodore, T.G., 1991, Preliminary geologic map of the Valmy quadrangle, Humboldt County, Nevada: U.S. Geological Survey Open-File Report 91-430, scale 1:24,000.

Theodore, T.G., 1994, Preliminary geologic map of the Snow Gulch quadrangle, Humboldt and Lander Counties, Nevada, with a section on Radiolarians in the

Theodore, T.G., 1998, *in press*, Geology of pluton-related gold mineralization at Battle Mountain, Nevada: Tucson, Arizona, University of Arizona and U.S. Geological Survey Center for Mineral Resources, Monograph 2.

Copy to: Office of Environmental Policy and Compliance

Cc: W. Rast, WRD
P. Helm, GD, AZ
EAP Chron, MS 423
EAP Review, MS 423

USGS: WRD: WRAST:PHLEM:JBURTON:bjohnson:x6832:03/16/00
C:/worddocs/eiscomments/marigoldmine.doc

# Letter 5

KENNY C. GUINN
*Governor*

STATE OF NEVADA
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

**DIVISION OF WILDLIFE**
1100 Valley Road
P.O. Box 10678
Reno, Nevada 89520-0022
(775) 688-1500 • Fax (775) 688-1595

PETER G. MORROS
*Director*
Department of Conservation and Natural Resources

TERRY R. CRAWFORTH
*Administrator*

March 17, 2000

Gerald Moritz
EIS Project Manager
Winnemucca District
Bureau of Land Management
5100 E. Winnemucca Blvd
Winnemucca, NV 89445

RE: Draft Environmental Impact Statement, Marigold Mine Expansion Project, Glamis Marigold Mining Company, Lander/Humboldt Counties, Nevada - BLM

Dear Mr. Moritz:

We appreciate the opportunity to review and provide comments on the subject document.

5-1 On Page 2-20, in Section 2.2.8, Tailings Impoundment, the document indicates the design specifications of the leak detection system are not included in this document. It would be helpful to the reader to have this information included in the document. This is particularly true with the fact that the existing tailings pond is leaking and contaminating groundwater. Numerous leak detection systems are presently in place at other mining operations in Nevada. These facilities have leak detection systems. It should be possible to have this information available for this document.

5-2 On page 2-26, in Section 2.2.18.2, Waste Rock Characterization, the document indicates any potentially acid generating rock would be subject to a BLM-approved materials management plan. Would this plan undergo additional NEPA review?

5-3 On page 2-32, in Section 2.2.19.3, Surface and Seedbed Preparation, the document indicates 6-12 inches of growth medium would be distributed over the recontoured disturbances. Later in the document in the Soils section, on page 3-71, the analysis indicates there is up to 16 inches of topsoil available. Why is Glamis proposing to not utilize all of the topsoil resource? In general the deeper the topsoil the better the success of seeded species, particularly the shrub species. We would recommend all of the topsoil available be used in the reclamation effort.

5-4 On page 2-37, in Section 2.2.19.8, Facility Reclamation, in the discussion of the tailings reclamation, the document indicates again that 6 inches of growth medium would be placed on top of the waste rock covered tailings. If adequate topsoil is available, we would recommend a greater topsoil depth be used. This would enhance the success of shrub seedings and seedlings. Better shrub success would enhance the evapotranspiration (ET) effectiveness of the tailings cover and more adequately meet the post mining land use objective of wildlife habitat.



# Responses to Letter 5

5-1 Detailed design specifications for engineered components are beyond the scope of this document. Once submitted, these plans would be available for review at the NDEP. The sentence, "The number and locations of monitoring wells established downgradient of the tailings impoundment would be determined by the NDEP and other appropriate agencies." was added to Section 2.2.8, Tailings Impoundment, as a result of the comment.

5-2 The Sulfide Waste Management Plan has been approved by BLM. No additional NEPA review is required at this time.

5-3 Based on reclamation studies that have been completed at the Marigold Mine and the successful reclamation of the existing 8-South Waste Rock Dump, the use of 6 to 12 inches of growth media would be adequate for the reclamation of disturbed land and the establishment of vegetation.

5-4 See response to Comment 5-3.

# Letter 5 Continued



5-5 On page 3-23, under the heading Tailings Impoundment Hydrology, the document indicates the existing tailings impoundment has been seeping contaminants into the ground and in fact intercepting the ground water near the mine site. On page 3-28, under the heading of Environmental Consequences, the document discusses what Glamis has done to deal with this issue. What will be the long term remediation of this leakage? Who will maintain the pumpback system that is proposed to dewater the contaminant plume? This information should be included in this section of the document to indicate what the long term resolution will be.

5-6 On page 3-29, under the heading Heap Leach Facility, the document indicates long-term management of the heap leach draindown has not been analyzed. Why has this analysis not been done or included in this document? Will another NEPA analysis be conducted to evaluate this process?

5-7 On the same page, the next paragraph, the document discusses the Greenworld method of heap closure. The document states there is a potential for this method to contaminate the groundwater through land application of the rinsate. Why would this be done?

5-8 On page 3-31, in Section 3.1.2.2, 8-South Partial Backfill Alternative, the document indicates rainwater infiltrating through the waste rock backfilled into the pit could potentially create seepage of water with elevated levels of arsenic, mercury and molybdenum. If ET technology is included in the design of the reclamation of the material backfilled into the pit, the amount of seepage of rainwater into the ground could be greatly reduced or eliminated. Has this technology been considered?

5-9 On page 3-42, in Section 3.2.1.4, Mineralization, in the last sentence in the last paragraph, the document states the Trenton Canyon Project is not in production. This is a contradiction of the information given on page 2-47, in Section 2.6.1, Past and Present Actions.

5-10 On page 3-82, in Section 3.5.2, Environmental Consequences, in the first paragraph the document indicates the removal of mature shrubs may be a long term impact because it may take 5 to 10 years for mature shrubs to become reestablished following reclamation. In the very next sentence the document indicates that reclamation studies at the Marigold Mine have shown mature sized shrubs can be established in 3 to 5 years. These statements seem contradictory.

5-11 On page 3-91, in Section 3.6.3, Cumulative Impacts, the last sentence states " The location of these natural resources, relative to the duration of the human disturbance, is pertinent to the degree or level of anticipated cumulative impacts." What is this statement trying to say?

5-12 On page 3-93, in Table 3-17, the pygmy rabbit is listed as a BLM special species. We believe the pygmy rabbit is no longer given special status by the Bureau.

# Responses to Letter 5

5-5 GMMC would continue to control and remediate tailings seepage under the guidance and direction of NDEP.

5-6 See responses to Comments 1-12, 2-16, and 2-17.

5-7 See response to Comment 1-12.

5-8 The pit bottom would be backfilled and reclaimed with the implementation of the 8-South Partial Pit Backfill Alternative. Evapotranspiration associated with vegetation established in the pit bottom would reduce the amount of seepage into the groundwater. The column leach tests conducted on rock originating from the 8-North Pit, which would be used to backfill the 8-South Pit, indicated that acidic seepage or leaching of metals from the waste rock would not likely occur. Therefore, impacts to groundwater are not anticipated.

5-9 The 4th paragraph in Section 3.2.1.4, Mineralization, has been revised to read, "The Buffalo Valley Mine has had intermittent activity and the North Peak, Trenton, and Valmy (Trenton Canyon) deposits are currently being mined."

5-10 The sentence, "The removal of mature shrubs ...in the project area." has been deleted as a result of the comment. Text also was added to Section 3.5.2.1, Proposed Action, to address the comment.

5-11 The sentence, "The location of these natural resources ... anticipated cumulative impacts." at the end of Section 3.6.3, Cumulative Impacts, has been removed since this is addressed earlier in this section.

5-12 Since the pygmy rabbit is no longer listed as a BLM sensitive species, text regarding this species has been deleted from Table 3-17, and Sections 3.7.1.3 (Mammals), 3.7.2.1 (Proposed Action), and 3.7.2.3 (No Action Alternative). In addition, appropriate references also were deleted.

# Letter 5 Continued



5-13 On page 3-95, the first sentence characterizes the burrowing owl as an uncommon summer migrant. We believe the burrowing owl would be better characterized as a common summer resident. These birds have been noted near the project area and are generally found in this habitat type throughout this part of Nevada during the breeding season.

5-14 On page 3-97, in Section 3.7.2.1, Proposed Action, the document indicates no suitable nesting habitat for the golden eagle occurs in the immediate vicinity. It is a fact that golden eagles will utilize pit highwalls for nesting habitat. This has been documented in a least one mine in the Eastern Region. There is extensive highwall habitat in the vicinity of the mine.

5-15 On page 3-165, under the heading of Native American Concerns, the document indicates that forage kochia be not included in the seed mix. We are unsure why the mine and the BLM think this is necessary. This mine site is heavily infested with cheatgrass. Forage kochia has been shown to be very successful at competing against cheatgrass in revegetation project at numerous locations in this part of Nevada. We would suggest this species remain a consideration as a reclamation species in case the native shrubs have difficulty becoming reestablished on the reclaimed mine disturbances because of the interference of cheatgrass.

The Nevada Division of Wildlife appreciates the opportunity to contribute this information in an effort to provide the best possible environmental analysis to protect and benefit wildlife. We continue to look forward to working with the Bureau in developing this environmental document for the Marigold Mine Expansion Project. Please feel free to contact me for additional information or comments that you may have on this input.

Sincerely,

Rory E. Lamp
Biologist III
1375 Mountain City Highway
Elko, NV 89801
(775) 738-5332

RL

cc: Habitat Division
Larry Teske, Pete Bradley, John Gephardt
File

# Responses to Letter 5

5-13 See response to Comment 1-20.

5-14 Text has been added to the 3rd paragraph in Section 3.7.1.2, Birds, as a result of the comment.

5-15 Prostrate kochia is not included in the proposed reclamation mix for the following reasons:

- Prostrate kochia is an exotic species;
- Native Americans have expressed an interest in using only native species for reclamation; and
- The establishment of prostrate kochia may inhibit the establishment of native species.

# Letter 5 Continued



# Response to Letter 5

# Letter 6


## WESTERN SHOSHONE DEFENSE PROJECT

P.O. Box 211308, Crescent Valley, Nevada 89821
phone: 775-468-0230, fax: 775-468-0237, email: wsdp@igc.org


April 10th, 2000

Gerald Moritz, EIS Project Manager
Bureau of Land Management, Winnemucca Field Office
5100 E. Winnemucca Boulevard
Winnemucca, Nevada 89445

Dear Mr Moritz,

The following comments are being submitted on behalf of the Western Shoshone Defense Project, a Western Shoshone directed non-profit organization committed to the preservation of Western Shoshone rights and lands for present and future generations based upon cultural and spiritual traditions. Several staff people from the WSDP had the opportunity to take part in the Native American site visit to the Marigold Mine on July 28th, 1999. We appreciate this opportunity to tour the mine site and have a general understanding of its features and operations. Recognizing the necessity of water to all life, and its relative scarcity within the arid lands of the Western Shoshone Nation, we are particularly concerned with the protection of both ground and surface waters and the potential for the Marigold Mine expansion to further contaminate these waters. In its current form the DEIS does not provide adequate information to fully determine the impacts of this project or the mitigation necessary to prevent undue or unnecessary degradation of the surrounding lands and resources.

**Treaty of Ruby Valley**

The Marigold Mine and its proposed expansion lie within the Western Shohsone homeland known as Newe Sogobia, the people's earth mother. These homelands are recognized by the United States government in the 1863 Treaty of Peace and Friendship signed in Ruby Valley. With the signing of the Treaty the U.S. government had entered into a nation to nation agreement with the Western Shoshone nation. As an agreement between nations, it was recognized within the U.S. Constitution as the "supreme law of the land." Despite the many concessions granted to the U.S. by the Western Shoshone , the Treaty of Ruby Valley is significant because it ceded no land. And like all Treaties it did not grant rights to Indian people, it granted certain privileges and rights to the U.S., reserving all the sovereign rights and responsibilities possessed by the Nation unless specifically waived. Yet the rights of the Western Shohsone people to have any say over what happens to their traditional land base continued to be denied by the Bureau of Land Management and other Federal agencies. The Federal government has chosen to hide behind the fraudulent proceeds of the Indian Claims Commission in denying the continuing validity of our Treaty. By what Constitutional authority do the "findings" of a commission permit the violation of Treaties? The Supreme Court case U.S. v. Dann is often mentioned in reference to the Treaty. Title to Western Shoshone land was never litigated by this court. Federal District court has declared the Treaty of Ruby Valley as being in "full force and effect," and this has yet to be refuted by any U.S. court.

The Treaty of Ruby Valley is essentially an agreement by the Western Shoshone to share their lands with the newcomers. Article IV of the Treaty of Ruby Valley does permit mining within Western Shoshone territory. In 1863 visible quantities of silver and gold were mined on a human scale. It is also important to note that the Supreme Court's 'canons of treaty interpretation' require that Treaties be interpreted as the Indian people understood them at the time of signing, and that any ambiguities be interpreted in favor of the Indian people. There was no agreement to the current form of open pit, cyanide heap leach technology which permits the processing of gold which one would need an electron microscope to see. There was also no agreement to the destruction or contamination of water or cultural sites. The current BLM land management process in Newe Sogobia excludes Western Shoshone authorities from any decision making. The BLM's ongoing refusal to recognize Western Shoshone authority over the vast majority of their land base violates the Treaty of Ruby Valley, as well as international law protecting the rights of indigenous peoples. Because of the unwillingness of the United States government to honor its obligations to the Western Shoshone, Western Shoshone governments and individuals are currently addressing several International Human Rights Organizations in regards to this situation.

# Letter 6 Continued

## Current And Future Groundwater Contamination

6-1 We are especially concerned about the ongoing groundwater contamination from the leaking tailings pond. The DEIS fails to fully explain the extent and source of contamination. How much water has been impacted up to this point? There is no map of the plume and it is not clear where all the monitoring wells are located. Are the wells only located at the northern tip of the tailings facility or do they surround it to provide a more accurate picture of the lateral extent of the plume. Is the current tailings pond lined? The DEIS indicates that the leak(s?) was first detected in 1991, yet here we are 9 years later with the pond continuing to be used and the leak not stopped but only reduced from nearly 200 gallons per minute to 34 gpm. Even if we assume that the pond has leaked at the low rate of 34 gpm for the past nine years (and we know in years past it has leaked at higher rates), that amounts to 17,870,400 gallons of contaminated water entering the groundwater aquifer. This is unacceptable. Continuing use of this leaking facility for tailings storage would violate BLM regulations to prevent undue and unnecessary degradation, as well as Nevada regulations protecting groundwater quality.

The DEIS states that studies are currently being conducted to determine the feasibility of expanding the current tailings facility. These studies are vital part of determining the decision to approve this project and must be part of the DEIS. If the current tailings facility is clay lined, it does not seem wise to construct another with only a clay liner. Any new facilities designed to contain potenially hazardous fluids should be constructed with a double liner. No details of liner construction have been provided. It is stated that heap leach pads would be constructed with a synthetic and soil liners or synthetic and clay geomembranes. It would seem the synthetic plastic liner with elay geomembrane would provide a greater measure of protection for groundwater sources. Again we would remind the BLM that is has a responsibility to prevent undue or unnecessary degradation. When leaks impact the groundwater they have failed in this responsibility.

6-2 The potential of seepage from waste rock dumps and heap leach pads to impact groundwater is not adequately evaluated. The statement that this will not be a problem because of the arid environment and a clay soil layer is insufficient. Water is already contaminated under the tailings facility suggesting that the elay layer is not impermeable. A low level nuclear waste dump located outside of Beatty Nevada in a more arid area has already experienced the flow of contaminates far beyond what was predicted. The DEIS indicates that most of the seepage from the waste rock dumps is potentially hazardous to wildlife. Would this not represent a point source of pollution under the Clean Water Act? It is not clear how this will be prevented or successfully mitigated.

**Dewatering Impacts**

6-3 The DEIS indicates that dewatering from the Lone Tree Mine has dropped the water table under Marigold significantly. despite computer models to the contrary. For the past several years various Western Shoshone representatives have expressed their concerns and opposition to the ongoing deewatering in the area, with it potential to dry up springs and other surface waters important to wildlife and traditional cultural practices. In response the BLM and the mining industry has referred to computer models in suggesting that dewatering will have limited impacts. The enormous miscalculation in the Lone Tree model undermines the assessment of impacts and the development of mitigation that has been presented in previous EIS's including the Trenton Canyon DEIS/FEIS, Lone Tree DEIS/FEIS, and the Twin Creeks DEIS/FEIS. Current drawdown from pumping at Lone Tree suggests the potential for drying springs located near both the Marigold Mine and the Trenton Canyon mine that are important to wildlife. The BLM must reevaluate the impacts of these mines with current information regarding regional dewatering, and implement appropriate mitigation to prevent undue and unnecessary degradation.

## Reclamation

6-4 During the July site visit we were able to examine successful reclamation on what we believe was the 8 South Waste Rock Dump. We were very impressed with the diversity and density of plant cover that had been achieved there. We commend the Marigold mine for this effort, and feel that this should provide a good example to the mining industry of what can be achieved with the proper commitment. We want to see the entire Marigold site reclaimed to the same standard. We do not think the BLM has adequatley evaluated a full backfill alternative. Where are the studies and calculations to prove the economic infeasability of this alternative? We do not feel that the statement that a full backfill is rejected because it may cover gold deposits which may become feasible to develop in the future because of higher gold prices or advanced extraction technology is an adequate analysis. Higher gold prices or advanced extraction technology may indeed make it feasible to redevelop a previously backfilled pit. Backfilling would eliminate impacts associated with the creation of a pit lake and would also fully mitigate the loss of 700+ acres of mule deer winter range described in the EIS. This would be consistent with the BLM's responsibility to prevent undue or unnecessary degradation.

# Responses to Letter 6

6-1 Comment noted. The seepage from the existing tailings impoundment is currently under evaluation by the NDEP and GMMC. Based on groundwater monitoring conducted since 1991, groundwater quality has not been degraded beyond state drinking water standards. It is unlikely that NDEP and GMMC would allow groundwater degradation to exceed drinking water standards. Monitoring wells have been established downgradient (i.e., north side) of the existing tailings impoundment, as illustrated on Map 3-3. The new tailings impoundment would conform to all NDEP construction design and other requirements. The BLM does not regulate construction and operation of tailings impoundments; the state of Nevada regulates construction and operation of tailings impoundments.

6-2 Waste rock deposited in the waste rock dump areas would be dry and tailings slurry deposited into the tailings impoundment would be wet, consisting of approximately 50 percent water by weight. Therefore, seepage from waste rock would not likely occur except after major storms of long duration (4 to 5 days or more). This seepage would be minor and limited to the surface. A clay layer located approximately 80 feet below the surface would prevent seepage from reaching groundwater. Although some surface seeps of short duration may have elevated metals, these seeps would dry up quickly and not provide a source of water for wildlife. The Clean Water Act governs discharges to surface water bodies, not seeps from mine waste rock dumps.

6-3 See response to Comment 1-11.

6-4 Comment noted. See responses to Comments 2-2 and 2-4. Section 2.5, Alternatives Considered But Eliminated From Detailed Analysis, provides justification for eliminating the complete backfilling alternative.

# Letter 6 Continued

## Cultural Sites and Native American Consultation

6-5 Over the past several years Western Shoshone representatives have expressed their concerns to the BLM over the ongoing appropriation of their cultural heritage within their homelands. Anytime a project is permitted there is frequently archaeological work which proceeds without the consent of the Western Shoshone and removes artifacts for storage in the Nevada State Museum or other facilities. These artifacts, "data" for the archaeologists, are the visible, physical remains of the continuous occupancy and use of Western Shoshone homelands by the people since time immemorial. Through this process the United States is erasing the history of Western Shoshone on their lands. Any archaeological work done in conjunction with this project must be done with the full consent and participation of appropriate Western Shoshone representatives. Artifacts should not leave Western Shoshone territory. Because Federally mandated consultation has not been completed with the release of the DEIS, we feel that it is incomplete.

We appreciate the opportunity to comment on this project and hope the BLM will honestly address the issues and concerns raised here. The DEIS is inadequate in its current form and should be re-released with the necessary information.

Sincerely,

Christopher Sewall
staff, Western Shoshone Defense Project

# Responses to Letter 6

6-5 As stated in Section 3.14.2.1, Proposed Action, direct impacts to archaeological sites are not expected to occur in the Area of Potential Effect. Impacts to archaeological sites would be avoided with the implementation of the environmental protection measures described in Section 2.2.18.7, Cultural/Paleontological Resources. Consultations with the Western Shoshone (and others) were initiated for this project under the NHPA, AIRFA, ARPA, and other pertinent legislation. Consultations included visits to the mine site and meetings where comments from tribal representatives were solicited. These comments were addressed in the EIS. Reports summarizing comments received at the meetings and during mine site visits are on file at the Winnemucca BLM Office.

# Letter 7

April 8, 2000

Great Basin Mine Watch

P.O. Box 10262
Reno, NV 89510

phone 775-348-1986
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gbmw@nevadawilderness.org

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Gerald Moritz
EIS Project Manager
Bureau of Land Management
Winnemucca Field Office
5100 E. Winnemucca Boulevard
Winnemucca, NV 89445

Dear Mr. Moritz:

Thank you for this opportunity to review the subject Draft Environmental Impact Statement (DEIS). Please consider any correspondence regarding the Marigold Mine previously received from *Friends of Nevada Wilderness* as a preliminary input from *Great Basin Mine Watch*. Also, please change all addresses in your data base for minerals or oil and gas from *Friends of Nevada Wilderness* or Tom Myers to the address on this letter. Thank you in advance for that.

The proposed mine will undo some of the good aspects of the current mine including partial pit backfill of some of the pits. The mine will illegally pile waste rock and tailings on public land which is especially egregious in this case because pits could be backfilled or private land used for the facilities. These thoughts will be expanded and more added in the discussion that follows.

Also, some of the comments below may appear to be focused on the proposed action rather than the agency preferred alternative. This is because we had not noticed the one paragraph that described the agency preferred alternative as the 8-South Partial Pit Backfill alternative (DEIS at 2-38). Of course, this alternative may be somewhat moot because the 8-North Pit, which will provide the rock to backfill the 8-South Pit, will not be developed unless the price of gold goes above $400/ounce (DEIS at 2-1). It seems that the true mine plan should be the proposed action without development of the 8-North Pit but also without backfilling the 8-South Pit. More on this below. 7-1

It is also interesting that this proposal was designed for gold worth $400 an ounce (DEIS at 2-1). It is very unlikely that this price will be seen anytime soon. Is this project still profitable at today's prices? This is an essential consideration for the BLM because discovery of a valuable mineral at this site exists only if the mining company can profitably produce the mineral. As you may know, the Forest Supervisor of Siskiyou National Forest recently denied a plan partially based on the doubt that the company could profitably mine the ore at the site. As the supervisor wrote: "[a]ll information on the record about the value of the minerals within the proposed mine sites indicates that production costs far exceed potential revenue. The proponent has not provided credible evidence to refute this information."

*Every truth passes through three stages before it is recognized. In the first, it is ridiculed. In the second, it is opposed. In the third, it is regarded as self-evident. Schopenhauer*

# Responses to Letter 7

7-1 A mitigation measure has been added to Section 3.1.4, Potential Mitigation/Monitoring, which includes the backfilling of the 8-South Pit. This measure would apply even if the 8-North Pit is not developed.

(Nicore Mining Plan of Operations, Record of Decision, R6-11-079-99, Forest Service, Pacific Northwest Region, 8/99, at 7). Similar concerns may exist here and this analysis should be redone to consider the mining plan at $270/ounce (approximate current price). We are very worried that the mine will be started and not be profitable leaving the public with a disturbed landscape and no mine benefits.

**The Plan of Operations Must Be Rejected As Violating The Mining Law**

The mine will be built on a combination of public and private land. Unfortunately, the plan appears to use all lode claims. Map 1-4 in the DEIS shows claims that are all at least 20 acres, the size of a lode claim. Comparison of Map 2-2 with Map 1-4 reveals instances of ancillary facilities being built on lode claims on public lands. The mining claims summary (Table 1-2, DEIS at 1-10,11) does not indicate the type of claim. And it appears that lode claims located on public land will be used to pile waste rock, a clear violation of the mining law as explained below.

It appears that up to 255 acres of public land are potentially damaged illegally.
Thus, the summary statement that "GMMC complies with the BLM Instruction Memorandum No. 98-154, as the proposed mine expansion would not exceed the legal limit of 5 acres of mill site claims for each associated lode claim"[1] is not correct because there are no millsite claims[2]. The map shows claims dividing sections into 20 acre unit. If this is incorrect, please include a map that accurately depicts millsite claims.

7-2

As stated, there appears to be no millsite claims on which ancillary facilities, including the waste rock dumps, may be built. If any millsite claims are filed and/or used in the project, their number is strictly limited by the Mining Law. As held by Secretary Babbitt and Solicitor Leshy, only five acres of millsite lands can be used per valid lode claim that is proposed to be excavated/developed for this project. See Memorandum entitled "Limitations on Patenting Millsites under the Mining Law of 1872," M-36988, from Interior Solicitor Leshy to the Director of the BLM (November 12, 1997) (with concurrence by Secretary Babbitt).

Without millsite claims, the project can only be approved if all of the lode claims proposed for use adhere to the strict limitations on the validity and use of lode claims. Chief among these limitations is the requirement of a discovery of a valuable mineral deposit on every lode claim proposed to be used and the further limitation that even valid lode claims can only be used if actual extraction is proposed to occur on that claim. These requirements were recently affirmed by Assistant Secretary Baca and Solicitor Leshy and thus are binding upon the BLM. See Letter from Sylvia Baca, Acting Assistant Interior Secretary, Land and Minerals Management; James

---

[1]DEIS at v. This was the conclusion to the issues raised about the legality of mine claims within the project area.

[2]It is not necessary to address the questionable legality of IM 98-154 in light of recent Secretarial decisions at Crown Jewel which would override a simple instruction memorandum because there is no millsite issue here unless several maps and tables in the DEIS are incorrect.





7-2 The Bureau of Land Management (BLM) has responsibility to balance the inherent right to mine as afforded under the Mining Laws and the conditional right to mine under the Federal Land Policy and Management Act (FLPMA). FLPMA Section 302 (a)(b) states in part, that BLM is mandated to:

- Manage the public lands "under principles of multiple use and sustained yield."
- Directs the Secretary to "regulate, through easements, permits, leases, licenses, published rules, or other instruments as the Secretary deems appropriate, the use, occupancy, and development of the public lands,"
- "no provision of this section or any other section of this act shall in any way amend the Mining Law of 1872 or impair the rights of any locators or claims under that Act, including, but not limited to, rights of ingress and egress,"
- "In managing the public lands the Secretary shall, by regulation or otherwise, take any action necessary to prevent unnecessary or undue degradation of the lands."

The Mining Laws establish a policy, in the national interest, to encourage private enterprise to develop, research and reclaim mineral development operations. See 30USC§21a. A claim is "legal" if it is located, recorded, and maintained in accordance with §313 of FLPMA, the Mining Law, and Nevada's laws for governing mining claims. The Surface Management Regulations 43 CFR 3809 were developed to meet requirements of the Mining Laws and FLPMA, by preventing undue and unnecessary degradation of Federal lands. Mine *plan of operation* approvals are rendered through the 43 CFR 3809 regulations for operations located on BLM-administered lands.

Comments from Great Basin Mine Watch (GBMW) allege that the Marigold Mine is in violation with the Mining Law of 1872, with respect to the November 1997 Department of Interior, Solicitor's Opinion and from claim validity issues.

In November 1997, Department of Interior Solicitor, John D. Leshy issued a legal opinion to the Director of the BLM, titled "Limitations on Patenting Millsites Under the Mining Law of 1872." The opinion was subsequently reviewed and concurred with by the Secretary of the Interior. The opinion examined the Mining Law of 1872, as it relates to millsite locations and their relationship with associated lode or placer claims. The conclusion is that each lode or placer claim may have only five acres of millsite associated with it. A millsite claim is limited to a maximum of five acres in size.

# Letter 7 Continued

R. Lyons, Under Secretary, Natural Resources and Environment, Department of Agriculture; Charles R. Rawls, General Counsel, Department of Agriculture; and John D. Leshy, Solicitor, Department of the Interior, to Greg Etter, Vice President and General Counsel, Battle Mountain Gold Company (March 25, 1999)(the "March 25th Crown Jewel Mine Decision").

The March 25th Crown Jewel Mine Decision based its rejection of the Plan of Operations (PoO) on two fundamental requirements of the Mining Law. One involved the limitations on the number and acreage of millsites that an operator could utilize in conjunction with its Plan of Operations. The other involved the limitations on the use of lode mining claims, as well as the requirement for claim validity.

The March 25th Decision stated that the Interior Department could not approve a PoO based on a claim situation similar to that at Marigold because the Mining Law does not allow for a mining claimant to make use of the surface resources of a lode claim unless that claim is proposed for actual mining. The Interior and Agriculture Departments specifically stated:

> No rights of any kind attach to invalid mining claims or mill sites.... While the Mining Law does permit the use of a valid lode claim for facilities that are ancillary to mining on that claim, it does not permit the use of a lode claim for facilities to support mining solely on other lode claims. For this reason, the lode claims BMG has identified for mill site use likely are invalid.

7-2

March 25th Decision, at 1-2 (emphasis in original, citations omitted).

The Department's Decision was based on a fundamental reading of the Mining Law. Under the Mining Law, locators of valuable minerals on the public lands acquire certain rights to use the surface of those lands contained within the boundaries of a valid claim. See 30 U.S.C. § 26. The right to use the surface of these lands is not, however, without limitation.

Specifically, the Mining Law requires that the surface of a valid claim may only be used for purposes incident to the extraction of minerals from that claim. Teller v. United States, 113 F. 273, 280 (8th Cir. 1901)(cited with approval by the March 25th Decision at 2, n.6); United States v. Rizzinelli, 182 F. 675, 684 (D. Idaho 1910). This rule was affirmed by the IBLA in Bruce W. Crawford, 86 IBLA 350, 359-62 (1986). "More important for our purposes, the [Rizzinelli] court also essentially accepted the Government's argument that the holder of an unpatented mining claim was possessed of the exclusive use of the surface of the claim `only for purposes connected with or incident to the exploration and recovery of the mineral **therein contained**. [Rizzinelli] at 681.'" Crawford at 361 (emphasis added).

Here, the Marigold project proposes to use the surface of numerous mining claims solely for waste disposal, leaching, and other ancillary uses of materials extracted entirely from **other** mining claims (along with other non-mining uses), without any intention of extracting any valuable minerals whatsoever from those claims. Any such use of these mining claims' surface resources violates the inherent limitations contained within the Mining Law.



# Responses to Letter 7

The Solicitor's Opinion states in part "because the statute does not support issuing patents for millsite claims totaling more than five acres per placer or lode claim, the Department should reject those portions of millsite patent applications that exceed this acreage limitation. In addition, the Bureau should not approve *plans of operation* which relay on a greater number of millsites than the number of associated claims being developed unless the use of additional lands is obtained through other means." The Marigold Mine has been in operation since 1988. A preliminary draft plan modification for the "Life of Mine Expansion" was received in September of 1997, approximately two months prior to the issuance of the Solicitor's Opinion.

Throughout their comment letter GBMW, references the Crown Jewel Decision. On March 25, 1998, the BLM issued a 43 CFR 3809 Decision to the Crown Jewel Mine, rejecting the mine Plan of Operations. The Decision was based on the Solicitor's Opinion for limitations of millsite acreage to lode claims and limitations in the use of lode claims. Through legislative riders to appropriation bills during the fiscal year 1999 budget process, Congress provided rules contrary to the Solicitor's Opinion allowing for authorization of the Crown Jewel Mine. The question arises if the legislative riders to appropriation bills expire at the end of the fiscal year of the appropriation (September 30, 1999). According to the conference report, which accompanied H.R.1141, the report language shows the intent to restore mine plan approvals as they existed before the Solicitor's Opinion. Recent interpretation of this position is reinforced by Interior Board of Land Appeals (IBLA). "To the contrary, the Conference Report language, which we quote in full below, showed an intent to restore the status quo as it existed otherwise." See The Wilderness Society and Great Bear Foundation 151, IBLA 347, (2000).

The BLM has reviewed the Glamis/Marigold Mine expansion proposal with respect to the Solicitor's Opinion. Table 1-2 and Map 1-4 included in this FEIS, shows Glamis/Marigold Mine holding 69 millsites. Review of the associated lode claims being developed is approximately 69 claims. Based on the ratio comparing millsite to associated lode claim, BLM has determined Glamis/Marigold complies with the millsite ratio as presented in the Solicitor's Opinion and the Mining Law of 1872 (see Map 1-5).

# Letter 7 Continued

In Rizzinelli, the Court stated that under the Mining Law, "[t]he government gives the mineral to him who finds it, and, for purposes incident **to the extraction thereof**, permits him to possess **and use the ground in which it is found.**" 182 F. at 683 (emphasis added). Similarly, in Teller, the Court held that the Mining Law "confers a right, subject to certain limitations and conditions, upon a locator, **to work the claim for precious metals** for all time, if he desires to do so; but confers no right to . . . make use of the surface of **the claim**, except so far as it may be reasonably necessary in the legitimate operation of mining." 113 F. at 280 (emphasis added). Therefore, both of these cases hold that a mining claimant's right to possession of a mining claim exists only to the extent that the claimant makes efforts to actually extract valuable minerals from that claim (i.e., to "use the ground in which it [the extracted mineral] is found").

Teller was premised on the notion that if a mining claimant could use an unpatented claim for any purpose other than those incident to the extraction of minerals from that same claim, appropriation of land under the Mining Law would be rife with abuse. Id. at 282. The Court wanted to avoid the situation where a claimant could stake a location, make use of the land purely for its surface resources, and then abandon the claim, leaving it in a denuded state, and rendering it less valuable for mining or any other purpose. Id. Given these strong decisions and rationale, the Mining Law requires that each and every mining claim be used only for the extraction of minerals and such other purposes as are reasonably incident to that extraction on that claim.

7-2

In addition, the March 25th Decision correctly noted that massive waste dumping on many lode claims evidence the likely invalidity of the claims themselves. "The validity of these lode claims is also questionable because permanent deposit of waste rock indicates [the PoO applicant's] own belief that the lode claims do not contain a valuable mineral deposit, one of the fundamental requirements for a valid mining claim." March 25th Decision at 3, n. 7. As previously stated, the Marigold project will create substantial new waste rock dumps on lode claims.

Use of a mining claim for the sole purpose of a waste rock dump for materials extracted entirely from other claims severely jeopardizes the claimant's possessory rights to that claim by increasing the costs associated with the development to such an extent that the deposit may no longer be marketable.

Under the Mining Law, each valid unpatented mining claim must be supported by the discovery of a valuable mineral deposit. 30 U.S.C. § 23; United States v. Coleman, 390 U.S. 599 (1968). In Coleman, the United States Supreme Court upheld a decision of the Secretary of the Interior which ruled that to qualify as a valuable mineral deposit "it must be shown that the mineral can be 'extracted, removed and marketed at a profit'—the so called 'marketability test.'" Id., 390 U.S. at 600, 88 S.Ct. at 1329.

"A discovery, once made, may be 'lost' through the occurrence of any one of a number of events." United States v. Reynders, 26 IBLA 131 (1976). The "[l]oss of discovery from any cause defeats the validity of a mining claim before the issuance of a patent." United States v. Azurite Gold Co., BLM-1962-2 (Mining)(1962). With respect to unpatented claims, "[t]he



# Responses to Letter 7

Addressing claim validity issues presented by GBMW, BLM's actions in connection with the preparation of an EIS and approval of a *plan of operations* are guided by federal statutes and regulations as well as internal policies. The primary regulatory tool used by BLM is the Surface Management Regulations 43 CFR 3809 to approve mine *plans of operation*. The authority for these regulations are found in 43 CFR § 3809.0-3. The objectives of the 3809 regulations are defined under section 43 CFR 3809.0-2(a)(b)(c). Objective 3809.0-2 (a) states: "Provide for mineral entry, exploration, location, operations, and purchase pursuant to the mining laws in a manner that will not unduly hinder such activities but will assure that these activities are conducted in a manner that will prevent unnecessary or undue degradation and provide protection of non-mineral resources of Federal lands." Mining operation must comply with the 3809 regulatory requirements prior to approval of *plans of operation*. The BLM may choose but is not required to consider validity of claims when permitting a *plan of operations*. The purpose of the 43 CFR §3809 regulations is to "...prevent unnecessary or undue degradation of Federal lands which may result from operations authorized by the mining laws." These regulations do not address rights associated with mining or millsite claims nor do they state mining claims are required. There are no requirements to conduct a validity examination for preparation of an EIS or approval of a *plan of operations*.

In fact, there is no requirement for operators to own or control mining claims in order to mine or explore on federal lands under the 3809 regulations. The definition of "operations" at 43 CFR 3809.0-5(f) states in part; "Operations means all functions, work, facilities, and activities in connection with prospecting, discovery and assessment work, development, extraction, and processing of mineral deposits locatable under the mining laws and all other uses reasonably incident thereto, whether on a mining claim or not,..."

There are some circumstances separate from the Surface Management Regulations 43 CFR 3809, which may warrant investigation of unpatented mining claims. These circumstances include claims located in a designated wilderness area, claims located on withdrawn lands, or circumstances suggesting the claims are not part of a bona fide mining operation. None of these circumstances are present in connection with the proposed Marigold Project.

BLM guidance for land open to operations of the Mining Law, is defined in Instruction Memorandum (IM) 98-154. According to the IM, BLM is to determine if the plan proposal unacceptably conflicts with other significant resources within the plan area. If there are no unacceptable conflicts, BLM "need not evaluate the millsite-acreage-to mining-claim ratio involved in the plan." The proposal must still satisfy all other requirements of the Surface Management Regulations 43 CFR 3809. The 3809 approval, "in effect, serves as a surface use permit under section 302 (b) of the FLPMA, as well as authorizing under the Mining Law." BLM has not identified any unacceptable conflicts from the proposed Marigold Project.

primary title, the paramount ownership, is in the government, and upon abandonment by the locator, *or his failure to comply with the conditions upon which his continuing right of possession depends*, the entire estate reverts to the government." Rizzinelli, 182 F. at 681.

In this case, the proposed waste rock dumping would almost certainly make the extraction of the underlying mineral ore unprofitable. It would be very unlikely that an ore body could be rich enough to move a multi-million ton waste rock dump. Thus, a valuable discovery would no longer exist and all of the claimant's rights would revert back to the United States. In such circumstances, "no right arises from an invalid claim of any kind. All must conform to the law under which they are initiated; otherwise they work an unlawful private appropriation in derogation of the rights of the public." Cameron v. United States, 252 U.S. 450, 460, 40 S.Ct. 410, 412 (1919). Thus, the PoO violates the Mining Law by expressly approving for permanent use numerous mining claims for which the claimant will, upon their being covered with waste rock, have no valid rights to possess.

Based on the fact that use of the lode claims violated the Mining Law, the March 25th Decision concluded that: "The ROD is clear that its selection of an alternative is valid only insofar as the unpatented mining claims **and** mill sites are valid. ... [T]he limitations the Mining Law places on mining claims ... have long been understood. In these circumstances, we have no choice but to enforce the law. Therefore, we hereby vacate the Crown Jewel Mine Record of Decision and cannot approve your proposed plan of operations at this time." Decision at 5 (emphasis added).

7-2 The BLM cannot approve a Plan of Operations that is based on either invalid claims or illegal uses of public lands. As the IBLA recently noted: "A mining claimant's rights as against the United States are acquired only under the General Mining Law, and unless and until the claimant meets the requirements under those laws, no rights can be asserted against the United States." Ronald A. Pene, 147 IBLA 153, 157 (1999). "**It is axiomatic that operations may not legally proceed on invalid claims.**" Id. at 158 (emphasis added). In another recent case, the IBLA stated:

> This Board has held that, as against the United States, a mining claimant acquires no vested rights by location of a mining claim. Even though a claim may be perfected in all other respects, unless and until a claimant is able to show that the claim is supported by a discovery of valuable locatable mineral within the boundaries of the claim, no rights are acquired. In addition, the continuing authority of the Department to inquire into the validity of claims so long as legal title remains in the Department has been repeatedly reaffirmed by the courts.

Rocky Connor, 139 IBLA 361, 365 (1997) (citations omitted). The IBLA dealt squarely with this issue in November of 1998, specifically rejecting the BLM's assumption that a mining claimant had a "right to mine." The importance of the IBLA's ruling regarding federal regulation of hardrock mining bears repeating in full:

> Initially, however, we wish to comment on a statement made by BLM in its Answer to appellant's SOR [Statement of Reasons]. In response to a suggestion by GBMW





IM 98-154 gives BLM further guidance with respect to validity of mining claims within a mine plan area. The IM requires the BLM to expressly state that the 3809 approval "does not warrant the validity of mining claims or millsites within the plan area." Specific language would be provided in the Marigold Project, Record of Decision (ROD) that reflects this validity language. IM 98-154 expired on September 30, 1999.

IM 2001-076, dated January 19, 2001, reissued guidelines contained in the expired IM 98-154. This IM reaffirms that for lands open to the operation of the Mining Law and for which the BLM has determined that the plan does not unacceptably conflict with other significant resources within the plan area (e.g., cultural sites or properties or sacred sites), the BLM need not evaluate the millsite-acreage to mining claim ratio involved in the plan. The proposed Marigold Project has been evaluated with respect to this IM and it has been determined from the analysis in this EIS that no unacceptable conflicts exist with other significant resources.

The proposed Marigold Project has been evaluated with IM 2001-077, dated January 10, 2001. It has been determined that the proposed project is subject to the millsite limitation based on the Plan of Operations that was submitted before November 7, 1997, and the lode claims relocated as millsites after November 7, 1997, but prior to the plan approval. BLM has evaluated the millsite to lode claim limitation and has determined that Glamis/Marigold complies with the millsite to lode claim limitation by meeting the millsite to lode claim ratio, as defined.

On January 18, 2001, Department of the Interior Solicitor, John D. Leshy issued another legal opinion, M-37004, with respect to location of mining claims and millsites. BLM has yet to receive an IM giving guidance as to how to address the opinion with respect to mining proposals. In general, the opinion requires that areas of proposed surface use be held by millsites rather than lode mining claims, and that the number of millsites must meet the ratio set out in the November 1997 Solicitor's Opinion. The proposed Marigold Project involves construction of waste rock dumps on portions of public land (T33N, R43E, Sections 8 and 20), that are located on lode claims rather than millsites. In order to satisfy issues raised by M-37004, the BLM ROD will contain a stipulation requiring that portions of the proposed wasterock dumps in Sections 8 and 20, shall not be constructed until Glamis/Marigold Mine properly files millsite claims and submits for BLM review and concurrence, data showing the claims to be non-mineral in character. At that time, the millsite to lode ratio will again be evaluated by BLM to ensure that Glamis/Marigold fully complies with the Mining Law with respect to the location of mining claims and millsites.

# Letter 7 Continued

[appellants] that BLM should have either returned the mining plan of operations to Cortez [plan applicant] unapproved or required Cortez to supplement its filings, BLM declared:

> Since returning the plan of operations and demanding Cortez provide information on the South Pipeline is not provided for in its regulations, further discussion (returning the plan) by the BLM on this issue is not warranted. In addition, the Mining Law of 1872, as amended and the 43 CFR 3809 regulations provide mining proponents on Public lands the right to mine. As long as the BLM ensures compliance with its 43 CFR 3809 regulations and "undue or unnecessary degradation" is prohibited, the BLM must process and permit a plan of operations filed by a proponent.

(Answer at 10.) In our view, this declaration both overstates the rights of "mining proponents" and understates the authority of the BLM.

First of all, the mere filing of a plan of operations by a holder of a mining claim invests no rights in the claimant to have any plan of operations approved. Rights to mine under the general mining laws are derivative of a discovery of a valuable mineral deposit and, absent such a discovery, denial of a plan of operations is entirely appropriate. This, in fact, was the express holding in Southwest Resource Council, 96 IBLA 105, 123, 94 I.D. 56, 67 (1987). See also Robert L. Mendenhall, 127 IBLA 73 (1993); Southern Utah Wilderness Alliance, 125 IBLA 175, 188-89, 100 I.D. 15, 22 (1993).

7-2

Moreover, in determining whether a discovery exists, the costs of compliance with all applicable Federal and State laws (including environmental laws) are properly considered in determining whether or not the mineral deposit is presently marketable at a profit, i.e. whether the mineral deposit can be deemed to be a valuable mineral deposit within the meaning of the mining laws. See, e.g., United States v. Pittsburgh Pacific Co., 30 IBLA 388, 405, 84 I.D. 282, 290 (1977), aff'd sub nom. South Dakota v. Andrus, 614 F.2d 1190 (8th Cir.), cert. denied 449 U.S. 822 (1980); United States v. Kosanke Sand Corp. (On Reconsideration, 12 IBLA 282, 298-99, 80 I.D. 538, 546, 47 (1973). If the costs of compliance render the mineral development of a claim uneconomic, the claim, itself, is invalid and any plan of operations therefor is properly rejected. Under no circumstances can compliance be waived merely because failing to do so would make mining of the claim unprofitable. Claim validity is determined by the ability of the claimant to show a profit can be made after accounting for the costs of compliance with all applicable laws, and, where a claimant is unable to do so, BLM must, indeed, reject the plan of operations and take affirmative steps to invalidate the claim by filing a mining contest.

Finally, insofar as BLM has determined that it lacks adequate information on any relevant aspect of a plan of operations, BLM not only has the authority to require the filing of supplemental information, it has the obligation to do so. We emphatically reject



# Responses to Letter 7

In summary, BLM has analyzed the proposed Marigold Project with respect to current BLM guidance, IM 98-154, 2001-076, and 2001-077. Since there are no unacceptable conflicts with other resources identified, there is no need to further evaluate the millsite to lode ratio. However, in the interest of conducting a full analysis, BLM fully analyzed the proposed project with the millsite to lode claim limitation with respect to the Solicitor's Opinion and has concluded that the proposed project meets the ratio as identified in the Solicitor's Opinion. In addition, the proposal was analyzed with the most recent Solicitor's Opinion, M-37004. The ROD will include a stipulation ensuring Glamis/Marigold complies with the Mining Law and location of mining claims and millsites.

Claim validity issues are not present that would require BLM to conduct a claim validity examination nor does the Surface Management Regulations 43 CFR 3809 require BLM to conduct a claim validity examination of *plans of operation*. The fact that Glamis/Marigold has unpatented mining claims within the current and proposed active mining areas constitutes support of their validity.

> any suggestion that BLM must limit its consideration of any aspect of a plan of operations to the information or data which a claimant chooses to provide. Great Basin Mine Watch, 146 IBLA 248, 256 (1998)(emphasis in original).

The March 25th Decision confirms these points.

As indicated earlier, it is the discovery of a valuable mineral deposit and full compliance with all other statutory requirements that trigger a mining claimant's right to initiate mining operations on public land. Therefore, the BLM must uphold these legal requirements in order to satisfy its own obligation to minimize adverse environmental impacts.

The question of whether a claim is valid is an integral part of the BLM's analysis of a proposed mining project's operations, because if the BLM approves a mine before ascertaining whether the mining "rights" have any merit, the agency risks allowing an invalid mining operation to go forward in violation of federal mining law. In addition, because the BLM has the responsibility and the power to maintain and protect public lands, the agency has a duty to ensure that public lands, a resource held by the government in trust for the public, are not used improperly or illegally. As the IBLA recently confirmed:

> We recognize that a final determination that a claim is invalid for lack of discovery can be made only after a contest proceeding. See United States v. O'Leary, 63 Interior Dec. 341 (1956). We also recognize, however, that the mere location of a claim does not presumptively make it valid and that **an agency operating under a mandate to minimize surface disturbance may properly require the mining claimant to affirmatively establish the existence of a valid existing right, i.e., a discovery of a valuable mineral deposit, before allowing operations to proceed.** See, e.g., Southern Utah Wilderness Alliance, 125 IBLA 175, 188-89, 100 Interior Dec. 15, 22-23 (1993); Doyle Cape, 79 IBLA 204, 207 (1984); Havlah Group, 60 IBLA 349, 361 , 88 Interior Dec. 1113, 1121 (1981), appeal dismissed without prejudice, Havlah Group v. Watt, Civ. No. 82-1018 (D. Idaho Nov. 16, 1982).

7-2

Richard C. Swainbank, 141 IBLA 37, 44 (1997)(emphasis added). Although Swainbank involved mining claims in a National Park, the authority to require valid rights prior to authorizing operations that degrade public lands does not depend on whether the land is withdrawn from mineral entry. In other words, the standard for land protection applicable to a particular claim (e.g., National Park vs. BLM land) does not alter the Department's authority to require that lands are not jeopardized by illegal uses and/or invalid claims.

> "'The paramount ownership being in the government, and it also having a reversionary interest in the possessory right of the locator, clearly it has a valuable estate which it is entitled to protect against waste and unlawful use.'" United States v. Weiss, 642 F.2d 296, 299 (9th Cir. 1980) (quoting United States v. Rizzenelli, 182 F. 675, 681 (D. Idaho 1910)); *see also* Teller v. United States, 113 F. 273, 281 (8th Cir. 1901). Courts have upheld the federal government's authority to suspend approval of a plan of operations

until a claim's validity has been determined. Clouser v. Espy, 42 F.3d 1522 (9th Cir. 1994).

There can be no "right" to mine until the BLM has satisfactorily concluded its regulatory reviews, that is, determining whether the claimant has "compl[ied] with the laws of the U.S . . . ." 30 U.S.C. § 26. In addition, the BLM cannot approve a proposed mine until a claim's validity has at least been supported by credible evidence. Great Basin Mine Watch, 146 IBLA 248, 256 (1998). Indeed, a federal court found that "to the extent that [action by the federal land agency suspending approval of a plan might] have an indirect effect on plaintiff's 'rights' under their mining claims, I find nothing in the statutes to prevent this." Clouser v. Madigan, 1992 WL 694368, *4 (D. Or. 1992), *aff'd sub nom.* Clouser v. Espy, 42 F.3d 1522 (9th Cir. 1994) (finding that the Forest Service regulation limiting plan approval to "valid" mining claims does not violate the general statutes recognizing the mining rights of unpatented claims). Clouser was a case that involved operations proposed on mining claims in withdrawn and non-withdrawn areas. In order to satisfy its statutory and regulatory duties to protect public lands from undue degradation and to minimize adverse environmental impacts, the BLM must independently ascertain the nature of the "rights" at issue in its decisionmaking process.

In fact, this was the federal government's contention in Clouser v. Espy, the Ninth Circuit's most recent review of an agency's authorities under the Mining Law. "Under the relevant statutes and regulations, the [agency] need not permit mining operations until it is satisfied that the operator possesses a valid claim." Brief of U.S. Department of Justice (for Forest Service) at 18, Clouser v. Espy, 42 F.3d 1522 (9th Cir. 1994) (No. 93-35051). 7-2

In this case, the BLM cannot approve the PoO or any Record of Decision for a project that suffers from such fundamental violations of federal law. The BLM must inform the project applicant of this situation before proceeding further with the NEPA process.

Based on the Claim Problems, the BLM Must Analyze, and Indeed Can Only Approve, An Alternative That Complies With the Mining Law.

It is possible that the BLM will approve the Mine Plan despite the fatal problems with the Mining Law noted above. However, approval of the Plan would also violate NEPA and the APA.[3] In this case, such an approval would coincide with the rejection of the no-action alternative under NEPA. Rejection of the no-action alternative based on an assumption of mining claim validity would violate NEPA and the APA because such an assumption is not supported in the record.

NEPA is an action-forcing statute. Its sweeping commitment is to "prevent or eliminate damage to the environment and biosphere by focusing government and public attention on the environmental effects of proposed agency action."[4] It requires the federal agency to "consider

[3] National Environmental Policy Act of 1969 (NEPA), 42 U.S.C. § 4332 (1994); Administrative Procedure Act (APA), 5 U.S.C. § 706 (1994).
[4] Marsh v. Oregon Natural Resources Council, 490 U.S. 360, 371 (1989).

every significant aspect of the environmental impact of a proposed action,"[5] and to ensure "that the agency will inform the public that it has indeed considered environmental concerns in its decision making process."[6]

NEPA requires federal agencies to prepare an Environmental Impact Statement (EIS) for "all major federal actions significantly affecting the quality of the human environment."[7] An agency must prepare an EIS if "substantial questions are raised as to whether a project . . . *may* cause significant degradation of some human environmental factor."[8]

The consideration of alternatives is "the heart of the environmental impact statement."[9] It is "absolutely essential to the NEPA process that the decisionmaker be provided with a detailed and careful analysis of the relative environmental merits and demerits of the proposed action and possible alternatives, a requirement that we have characterized as 'the linchpin of the entire impact statement.'"[10] Moreover, "[t]he existence of a viable but unexamined alternative renders an environmental impact statement inadequate."[11]

7-2 The no-action alternative must be fully reviewed in each EIS. "The 'no action' alternative must also be considered in detail. 'Informed and meaningful consideration of alternatives—including the no action alternative—is . . . an integral part of the statutory scheme.'"[12] As noted above, the fact that a company has filed claims under the 1872 Mining Law does not preclude the agencies from adopting the no-action alternative when there is no determination that all claims are valid. As stated in *Great Basin Mine Watch* and the *Crown Jewel Mine Decision*, an agency should not approve a mine plan based on an unsupported assumption that the mining claims are valid.[13] Because the federal government may review and challenge the validity of any mining claim at any time,[14] the BLM must inquire into these issues at the outset of their NEPA and Mine Plan review processes.

The NEPA process is the primary means available to the public and to the decisionmaker to ascertain the environmental and social costs of the proposed project. A categorical rejection of the no-action alternative would be arbitrary when the agencies admit that the subject mining claims do not support the discovery of a valuable mineral deposit.

FLPMA outlines the BLM's obligations to protect public lands and to minimize adverse environmental impacts to the resource that the federal government holds in trust for the public.[15]

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5 Vermont Yankee Power Corp. v. Natural Resources Defense Council, 435 U.S. 519, 553 (1978).
6 Baltimore Gas & Elec. Co. v. Natural Resources Defense Council, 462 U.S. 87, 97 (1983).
7 42 U.S.C. § 4332(2)(c) (1994).
8 Greenpeace Action v. Franklin, 982 F.2d 1342, 1351 (9th Cir. 1992) (emphasis in original); LaFlamme v. FERC, 852 F.2d 389, 397 (9th Cir. 1988).
9 40 C.F.R. § 1502.14 (1998).
10 Natural Resources Defense Council v. Callaway, 524 F.2d 79, 92 (2d Cir. 1975).
11 Resources Ltd. v. Robertson, 35 F.3d 1300, 1307 (9th Cir. 1993) (quoting Idaho Conservation League v. Mumma, 956 F.2d 1508, 1519 (9th Cir. 1992)).
12 Alaska Wilderness Recreation & Tourism v. Morrison, 67 F.3d 723, 729 (9th Cir. 1995) (quoting Bob Marshall Alliance v. Hodel, 852 F.2d 1223, 1228 (9th Cir. 1989)).
13 Great Basin Mine Watch, 146 IBLA 248, 256 (1998); *Crown Jewel Mine Decision*, *supra* note 26.
14 Cameron v. United States, 252 U.S. 450 (1920).
15 43 U.S.C. § 1732 (1994); *see supra* note 91.

# Letter 7 Continued

The federal mining laws do grant claimants certain rights, but those rights are conveyed only when a claimant has made a discovery of a valuable mineral deposit or locates valid millsite claims associated with development of that deposit.[16] Therefore, the government can only recognize those rights after a valuable mineral deposit has been discovered.

The BLM has an obligation to meaningfully consider the no-action alternative because the legality of the use of most of the lode claims is seriously in doubt, if not outright illegal. Thus, for the vast majority of the project lands controlled by the federal government, the no-action alternative is the appropriate choice. More technically, though, the correct alternative is the "no federal lands for ancillary facilities" alternative since categorical denial of excavation of the mine pit's unpatented claim, if valid, may not be possible due to the rights inherent in valid claims. In this case, because the project proponent has many private holdings in the vicinity of the mine, it is possible to not use public land illegally as documented here. The project proponent also has the ability to backfill open pits by carefully planning its pit development. This is even acknowledged as an option (DEIS at 2-15).

7-2

In applying the "arbitrary and capricious" standard the APA, a court must consider "whether the agency has articulated a rational connection between the facts found and the choice made."[17] Both NEPA and the APA require that an agency's determinations be supported by factual information in the decision. "The agency must explicate fully its course of inquiry, its analysis, and its reasoning."[18] An agency decision must always have a rational basis that is both stated in the written decision and demonstrated in the administrative record accompanying the decision.[19] The decision must be made in a "careful and systematic manner."[20] The record must demonstrate a "reasoned analysis of the factors involved, made in due regard for the public interest."[21] Also, "[i]t is incumbent upon to BLM to ensure that its decision it supported by a rational basis and that such basis is stated in the written decision as well as being demonstrated in the administrative record accompanying the decision."[22]

In addition to violating the APA, a conclusion that the no-action/plan denial alternative is not viable because a mining claim is presupposed to be valid violates NEPA's requirement that an agency afford meaningful consideration to all reasonable alternatives. The courts have frowned upon this kind of biased approach to examining alternatives.[23] The "no federal lands for ancillary facilities"/no-action alternative is a viable alternative due to the lack of a discovery. Any BLM Final EIS and Record of Decision would be inadequate because the agency failed to adequately consider this alternative. Indeed, based on the facts of this case, approval of any other alternative would be illegal.

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16. *See supra* Section II.
17. Bowman Transp. Inc. v. Arkansas Best Freight Sys., 419 U.S. 281, 285-86 (1974) (cited in Exxon Corp. v. Department of Energy, 91 F.R.D. 26, 32 (1981)).
18. Dubois v. United States Dept. of Agric., 102 F.3d 1273, 1287 (1st Cir. 1996).
19. Kanawha & Hocking Coal & Coke Co., 112 IBLA 365, 368 (1990).
20. Edward L. Johnson, 93 IBLA 391, 399 (1986).
21. Alvin R. Platz, 114 IBLA 8, 15-16 (1990).
22. Larry Brown & Assoc., 133 IBLA 202, 205 (1995) (citing Edelman Community Property Trust, 106 IBLA 376, 377 (1989), Roger K. Ogden, 77 IBLA 4, 7 (1983)).
23. Citizens for Envtl. Quality v. United States, 731 F. Supp. 970, 990 (D. Colo. 1989) (finding that a "result-biased decisionmaking process prevented the Forest Service from establishing a legitimately broad range of reasonable alternatives as required by the statutory and regulatory scheme").

The proper avenue for a mining company seeking approval of ancillary activities is via the part 2920 special use regulations. For almost all of these uses, an applicant will need a long-term lease to cover the life of the activity.[24] Prior to authorizing such a use, the BLM must assure that it receives fair market value determined through an appraisal conducted in conformance with the Uniform Appraisal Standards for Federal Land Acquisitions.[25] As the preamble to the part 2920 regulations states: "*There is no statutory authority for issuing land use authorizations under section 302 of the Federal Land Policy and Management Act at less than fair market value.*"[26] The requirements for use authorizations under part 2920 can present significant obstacles to a mining operation hoping to obtain a lease for spent ore, waste rock, and tailings dumps. The BLM cannot approve such a use unless it "minimize[s] damage to scenic, cultural and aesthetic values, fish and wildlife habitat and otherwise protect[s] the environment."[27] Also, the BLM can deny the use if the use cannot "protect the public interest," among other requirements.[28] This discretionary authority is very different from the part 3809 plan of operations approval. The obvious distinction is that approval under 2920 is totally discretionary with the BLM. In contrast, the BLM must approve a mine plan of operation on valid claims unless the operation will cause "unnecessary or undue degradation." A key component of the 3809 regulations is the consideration of the economic impact on the operator of measures imposed by BLM in approving a plan of operations.[29] There is no such restraint under part 2920. The BLM must reject land use requests under part 2920 if environmental resources are adversely impacted, regardless of the financial impact on the mining company. Thus, the 2920 regulations apply to all ancillary facilities on public land at the Marigold project. The BLM should withdraw this DEIS and reexamine these facilities as a discretionary multiple use action.

7-2

**Why does GMMC's total property include 10,480 acres of public land?**

This statement sounds as if they control this land. If it is not their private land and it is not being mined, it should not be considered their property.
If the BLM considers this to be a part of the mine such that Glamis controls the property, **please explain the legal authority for such control.** There are sections shown on Map 2-2 that are to the west of the facility within the alleged GMMC property line that should not be needed for the mine.

7-3

**The document improperly eliminates alternatives from consideration.**

Any mine that has five pits could alter its operating plan to provide for pit backfill. The BLM should require mine sequencing to facilitate backfill. As we've written elsewhere, if ongoing

7-4

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[24] "Leases shall be used to authorize uses of public lands involving substantial construction, development or land improvement and the investment of large amounts of capital which are amortized over time." 43 C.F.R. § 2920.1-1(a) (1998). Large facilities for waste rock and tailings disposal clearly fall under this definition. In contrast, the two other types of land use authorizations under part 2920, permits and easements, are for shorter-term activities (permits apply to uses that do not exceed three years) or non-exclusive uses (for easements). *Id.* at § 2920.1-1(b) & (c).

[25] Preamble to part 2920 regulations. 46 Fed. Reg. 5772 (1981).

[26] *Id.* (emphasis added).

[27] 43 C.F.R. § 2920.7(b)(2) (1998).

[28] *Id.* § 2920.7(c)(6).

[29] One of the "objectives" of the 3809 regulations is that BLM "will not unduly hinder" mining operations. 43 C.F.R. § 3809.0-2(a) (1998).



7-3 The label "GMMC Property Line" has been replaced with "Private Land/Public Land Claim Boundary" on all appropriate maps in the EIS. In addition, text in Section 2.2, Proposed Action, has been revised to more accurately describe land owned by GMMC and mining claims controlled by GMMC on public-administered land.

7-4 See responses to Comments 2-2 and 2-4.

exploration finds viable minerals in a pit wall, then Glamis can amend the plan to allow for future development. The argument that backfilling may cover future resources is lame and is an excuse for allowing five huge craters to remain on northern Nevada's landscape.

7-4 Some of the backfill alternatives were rejected because of the cost of hauling. If an alternative is environmentally preferable, the BLM may choose it regardless of cost (Great Basin Mine Watch...). This empowers BLM managers with the authority to require the companies avoid undue degradation and not be concerned that the cost will render a mine unprofitable. It is not the BLM's job to make a mine profitable; it is the BLM's job to avoid undue degradation. Five open pits, huge craters, are clearly undue degradation[30]. This is especially true when considering that the waste rock dumps will be on public land in possible contravention of the mining law (see the discussion elsewhere).

**Please provide more detail about the tailings impoundment leaks.**

7-5 The discussion on page 2-19 just increases my interest in the issue. The discussion should be expanded to explain what contaminants are leaking in what concentration. Consider the following questions:

1. How is the flow rate from the tailings impoundment measured?
2. What did GMMC do as "corrective action"?
3. As the existing tailings pond fills, there will be increased gradient driving leakage. Why not start building the new facility which will apparently have a better liner system now?

Please provide contour maps of the contaminant concentrations so that the public may assess how far from the site the contaminants have moved.

**The reclamation discussion for heap leach pads (DEIS at 2-35,36) is insufficient.**

7-6 The DEIS describes three techniques for rinsing and detoxifying the heaps. Each of these methods have merit and we do not, at this time, purport to know which will work best. However, the DEIS does not discuss what will happen to water seeping through the heaps in perpetuity.

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[30]The BLM is required to avoid unnecessary or undue degradation. The conjunction is "or" which means that either unnecessary or undue must be avoided. In this case, the mining company cannot argue that leaving a pit is necessary. It is feasible to backfill pits, even if it requires the handling of waste rock twice. The only reason to avoid this is to maximize corporate profit which is not the BLM's responsibility. Because it is feasible, leaving open pits is NOT NECESSARY. Thus, it is possible to argue that leaving pits unbackfilled is BOTH unnecessary and undue.





7-5 The flow rate is estimated from changes in water levels in the tailings. Corrective action measures have included "blocking off" the northern end of the tailings impoundment to reduce water flow to the sump area and dewatering of the northern end (see Section 3.1.1.4, Groundwater Resources – Tailings Impoundment Hydrology). The northern end of the tailings would not be affected by addition of new tailings. The state of Nevada regulates tailings facilities, on private land. The state is guiding the efforts to reduce seepage and would decide whether additional tailings can be added to the impoundment. Currently, there is no groundwater contamination at the site; groundwater quality north of the tailings impoundment had been degraded with respect to TDS and chloride, but is still within state drinking water standards.

7-6 See responses to Comments 1-12, 2-16, and 2-17.

In the paragraph discussing the Greenworld Science Method, the DEIS suggests that draindown will be leached[31]. We believe that this is unacceptable unless the quality of drain down is better than NDEP's MCL values for each observed contaminant. It is also not acceptable for the leach field to be used for rinseate in perpetuity. The final EIS should state this. The preferred method is to keep meteoric water from seeping into the heaps. This requires several feet of clay with growth medium applied to the surface. We request that the final EIS include this discussion.

We also argue that it will be inappropriate for the BLM to respond that this will be discussed in NEPA documents or reclamation plans to be considered later. This is because the reclamation costs should be considered as a part of the cost of developing the mineral resource. The BLM should include reclamation costs in the consideration of whether a claim is valid which means that a prudent person would be able to profitably mine the mineral considering all of the costs. Reclamation costs are properly considered a part of developing the resource. Waiting until the mine is ready to close allows a company to plead poverty.

7-6

We are also very concerned about this issue being discussed up front because most heaps that have been closed have had difficulty reaching state standards. The regulating agencies must consider the cost and require bonding that reflects the long period of time required to detoxify heaps.

Please understand, we are mindful of the fact after mining is complete that a company may have a better idea how to close certain parts of a facility, including the heaps. In fact, new methods may be developed that will allow for better closure. We are and will be supportive of amendments to do the job better at closure. But we also want to avoid problems of a company not being able to afford closure by considering the costs now. In marginal ore bodies, as this one appears to be, high closure costs may render a mine unprofitable. It is the BLM's responsibility to consider these costs.

**The BLM should not allow the burial of synthetic liners for the process solution ponds (or any other facility).**

Synthetic (plastic) liners that are folded and allowed to remain in place are a toxic hazard just waiting for someone or some animal in the future to dig up. In all cases, the pond liners should be drained and the liner with all of the sediment and other materials should be removed and properly disposed of.

7-7

[31]Note that there is no indication in the document what will be done with the drain down in the other two methods.



7-7 The phrase, "5 feet below the surface" and text describing the disposal of synthetic liners and evaporates if the MWMP and TCLP test limits are exceeded, was added to Section 2.2.19.8, Facility Reclamation – Process Solution Ponds. Specific closure procedures for the process solution ponds would be provided in the Reclamation section of the approved Plan of Operations.

# Letter 7 Continued

**Glamis should provide 100-year, 24-hour storm capacity for all fluids management facilities.**

7-8 Marigold is situated in a variety of drainages which could convey surface water to the Humboldt River during a major spill. The freeboard on the solution ponds should be increased to avoid overflow during a 100-year event. Note that this will be required with the revised 3809 regulations and is good policy now. It would show Glamis' commitment to the environment.

**Streams should be returned to their original courses to the maximum extent possible.**

7-9 Stream diversions will change the natural gradient and meander pattern of the streams crossing the site. We acknowledge the need for diversions and agree that ephemeral washes can be diverted without causing undue degradation. However, it is inappropriate to leave the streams in their diversion ditches[32] forever. It is not a question of whether this will cause major aggradation and degradation, but when.

In natural conditions, the gradient and meander pattern of streams, including ephemeral streams, represents a dynamic equilibrium based on changing flow rate and sediment loading. Changing the gradient and meander pattern imposes changes on the stream's ability to carry its sediment load. Not putting the stream back into its original channel will increase the slope which will increase its sediment carrying capacity. A major event will eventually cause a knickpoint to form and a headcut to move upstream in these channels. Or, the planform may change and the streams will attempt to reestablish their original course which will put them back into the pits. Please do not respond that diversion structures will work forever; they will not. This could cause ephemeral pit lakes not analyzed by this document. If the pit is partially backfilled, streams flowing into the pit will cause wetting and drying periods which could contaminate groundwater[33].

Glamis will only monitor these channels through 2015[34]. The imposed gradient and planform will exist until Nature changes it and the BLM may have a larger problem than anticipated.

**Seepage through the waste rock of existing mines has contaminant levels that exceed state water quality standards. This will likely continue with the proposed mine.**

7-10 The description of water quality from existing waste rock and tailings on page 3-5 suggests provides an example of future problems if not adequately addressed. The proposals on page 3-28 are completely inadequate. A six inch cover will not prevent infiltration over the long run. The document does not provide or even address modeling results for this area. The wetting front

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[32]DEIS at 2-34.

[33]We recognize that the BLM proposes to isolate any pit backfill material that may be acid producing. Isolation would include straight backfill above the expected groundwater level. In other words, the BLM could allow pit backfill with potentially contaminating waste rock assuming that it will not be wetted by groundwater only to have surface drainage leach contaminants vertically downward.

[34]Id.



# Responses to Letter 7

7-8 Currently, the state of Nevada requires that solution ponds be constructed with a 2-foot freeboard to accommodate a 25-year, 24-hour storm event. As stated in Section 2.2.5.2, Solution Ponds/Collection System, the pregnant and barren solution ponds would be designed to hold the working volume of solution while maintaining a 2-foot freeboard following a 25-year, 24-hour storm event.

7-9 Streams cannot be returned to their natural courses after the project has been implemented. The only way to accomplish this would be through extensive backfilling of pits and removal of other project components. This would probably be physically infeasible as well as cost-prohibitive. Restoring stream courses across former project components in a manner that would prevent direct interaction with those component materials in perpetuity may not be achievable. Even if the drainages were lined, the liners would ultimately fail. Additional studies and design efforts for the diversions are underway, and these would address long-term closure issues as well as operational considerations. Currently, the conceptual diversion configurations appear to be flatter than the original drainage courses, which implies the potential for sediment aggradation. Further design efforts, including consideration of channel hydraulics, would be undertaken in the course of the project. Ultimately these issues would be addressed in permitting submittals to federal and state agencies, including the U.S. Army Corps of Engineers, as listed in Table 1-3 of the EIS. See response to Comment 3-1 regarding the monitoring of diversion channels.

7-10 See response to Comment 2-13. Seepage from waste rock dumps in an arid environment is rare and occurs only after major storm events. This seepage is limited to small surface seeps that dry up quickly. Computer modeling has not been completed for the Marigold Mine waste rock dumps. A 6-inch cover is generally adequate in arid environments for reducing infiltration into waste rock dumps.

from infiltration will often exceed 6 inches under natural conditions. Unlike these conditions, frequently infiltration to several feet will either reverse direction and be exfiltrated as temperatures rise and a vapor pressure gradient establishes. The difference in this situation is that exfiltration will not occur because the surface layer will effectively isolate moisture in the waste rock from the vapor pressure gradient. This occurs when pore spaces in the surface layer are larger than pore spaces in the lower layer. Once infiltration reaches the waste rock, it will move rapidly downward to the groundwater. There will be preferential flow paths that will cause fingers of seepage to reach the preexisting ground surface.

7-10 The document further incorrectly suggests that a clay layer in the alluvium underlying the site will protect water resources. Our concern is not with ground water contamination but with surface water discharges. The conductivity of the ground on which the waste rock is piled is much less than that of the waste rock. Seepage through the waste rock dumps will mostly be stopped and flow out onto the surface downhill from the waste rock. If infiltration does occur, the clay layer thought to protect the groundwater will merely cause the flow to divert horizontally toward surface sources including the Humboldt River.

Finally, please explain why Glamis does not have obtain discharge permits for the seepage through the waste rock.

**This DEIS raises serious questions about the adequacy of analysis for the Lone Tree Mine and the BLM's responses to the appeal filed by Great Basin Mine Watch.**

Great Basin Mine Watch appealed the Record of Decision and Plan of Operations for the Lone Tree Mine (N26-93-002P). A major contention of GBMW was that the groundwater model used to predict impacts due to dewatering was grossly inadequate. Now we find that is true. While not an issue for this mine document, it may be time to consider a supplemental environmental impact statement for the Lone Tree Mine.

**The DEIS fails to calculate Projected Emissions of $PM_{10}$.**

The DEIS does not calculate either a maximum 24-hour PM10 emission or an annual average emission due to PM10[35]. The DEIS merely uses measured values from 1992. There is no prediction of increases due to this project

7-11 To be correct, the BLM must calculate the **maximum** 24-hour $PM_{10}$ emissions by adding the **maximum** modeled 24-hour emissions from the Project with the **maximum** 24-hour baseline ambient concentrations.

The controlling EPA federal regulations control what the BLM must consider in this analysis:

[35]DEIS at 3-61. .



7-11 The NDEP is authorized to enforce the state and EPA federal regulations requiring that the proposed project meet the national ambient air quality standards. In the absence of actual measurements, the state agency may require air quality dispersion modeling to predict the 24-hour and annual impacts (concentrations). However, concentrations of air pollutants measured at locations near the property boundary are often considered to be more accurate than dispersion modeling in determining whether ambient air quality standards are being met. On-site measurements of $PM_{10}$ show that the mine is not causing violations of the 24-hour or annual ambient air quality standards for $PM_{10}$. Maximum 24-hr $PM_{10}$ impacts are expected to be similar to those highest values measured in the past.

(a) The level of the national primary and secondary *24-hour* ambient air quality standards for particulate matter is 150 micrograms per cubic meter ($ug/m^3$), **24-hour average concentration**. The standards are attained when the expected number of days per calendar year with a 24-hour concentration above 150 $ug/m^3$, ... is equal to or less than one.[36]
(b) The level of the national primary and secondary *annual* standards for particulate matter is 50 micrograms per cubic meter ($ug/m^3$), **annual arithmetic mean**. The standards are attained when the expected annual arithmetic mean concentration, ... is less than or equal to 50 $ug/m^3$.

40 CFR §50.6 (emphasis added). These regulations clearly show that the 24-hour standard is calculated using data representative of a 24-hour period and that the project will not violate standards if and only if the project does not cause concentrations to exceed the standards. Section (a) of the regulations, the 24-hour standard, specifically requires the use of the "24-hour average concentration." Section (b), the annual standard, utilizes the "annual arithmetic mean" -- the same calculation the DEIS incorrectly uses to determine the 24-hour emissions.

7-11

Consideration of these issues is critical to determine whether BLM can legally approve the mining plan of operations.

The DEIS is legally valid only if it is based on accurate scientific analysis. NEPA requires that "[a]gencies shall insure the professional integrity, including scientific integrity, of the discussions and analysis in environmental impact statements." 40 CFR § 1502.24. In this case, the DEIS' finding that the Project will comply with the 24-hour $PM_{10}$ standard is based on an assumption that ambient conditions during 1992 somehow represent the conditions to be caused by this project.

**The DEIS Must Analyze Potential Emissions of Criteria Pollutants, including $PM_{2.5}$**

In addition to problems with $PM_{10}$, the DEIS fails to analyze $PM_{2.5}$ emissions at all. The federal $PM_{2.5}$ standards are 65 $ug/m^3$ (24-hour) and 15 $ug/m^3$ (annual). 40 CFR § 50.7. $PM_{2.5}$ is particulate matter released by mine activities such as equipment emissions and fugitive dust. $PM_{2.5}$ was added as a criteria pollutant to the EPA regulations in 1997. Under NEPA, the BLM must ascertain the predicted level of emissions of criteria pollutants. Under FLPMA and the part 3809 regulations, BLM must be assured that the project will not violate any standards. Although it is likely that $PM_{10}$ emissions will be higher than $PM_{2.5}$, **all** of these standards must be met. Unfortunately, the public has no idea whether the Marigold Expansion Project can meet these standards -- let alone what the level of emissions would be. The DEIS fails to contain any detailed review of potential $PM_{2.5}$ and other criteria pollutant emissions.

7-12

[36] According to the Air Quality Impact Assessment Report for the South Pipeline Project prepared by EMA, 1998, at p. 9, note. b: "A violation of the Federal [$PM_{10}$] standard occurs on the second exceedence during a calendar year; a violation of the State of Nevada [$PM_{10}$] standard occurs on the first exceedence during a calendar year."



7-12 The promulgated $PM_{2.5}$ ambient air quality standard is currently remanded by the federal courts and is not in effect. All criteria pollutants and hazardous air pollutants were analyzed in the course of preparation of the EIS. Sources, types, and amounts of air pollutants are described in Section 3.3.2, Environmental Consequences.

The potential fact that other criteria pollutants, including $PM_{2.5}$, may not "have the greatest potential impact" in relation to other pollutants is not an excuse to omit review of these pollutants from NEPA. Further, the fact that $PM_{2.5}$ data may be currently lacking is not an excuse for failing to analyze the potential $PM_{2.5}$ emissions from the Project.

An EIS prepared pursuant to NEPA must include all relevant information at the time the agency makes a recommendation on a proposal for federal action. Kleppe v. Sierra Club, 427 U.S. 390, 405-406 (1976). Such information is largely useless if prepared after the fact. A central purpose of NEPA is to force the consideration of environmental impacts in the decision making process. That purpose requires that the NEPA process be integrated with agency planning "at the earliest possible time." 40 C.F.R. § 1501.2. The regulations also require that: "NEPA procedures must ensure that environmental information is available to public officials and citizens **before** decisions are made and **before** actions are taken." 40 C.F.R. § 1500.1(b)(emphasis added).

BLM's failure to analyze criteria pollutant emissions that may be released by the Project, particularly $PM_{2.5}$ emissions, violates NEPA's fundamental commitment to "prevent or eliminate damage to the environment by focusing government and public attention of the environmental effects of proposed agency action." Marsh v. Oregon Natural Resources Council, 490 U.S. 360, 371 (1989). NEPA requires the BLM to ensure "that the agency will inform the public that it has indeed considered environmental concerns in its decision making process." Baltimore Gas and Electric Company v. NRDC, 462 U.S. 87, 97 (1983).

7-12

> NEPA ensures that a federal agency makes informed, carefully calculated decisions when acting in such a way as to affect the environment and also enables dissemination of relevant information to external audiences potentially affected by the agency's decision. Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 349 (1989)...NEPA documentation notifies the public and relevant government officials of the proposed action and its environmental consequences and informs the public that the acting agency has considered those consequences....

Catron County Board of Commissioners v. U.S. Fish and Wildlife Service, 75 F.3d 1429, 1437 (10th Cir. 1996).

The CEQ NEPA regulations require that direct and indirect effects be adequately analyzed. 40 CFR §1502.16. Even those effects that may be beneficial must be reviewed. §1508.8. Thus, the BLM's rationale for failing to review the less significant, in its view, criteria pollutant emissions, is without merit. In other words, if the BLM has to review beneficial effects, it certainly has to review detrimental effects, including those it unilaterally believes are not as significant as other environmental effects. Under the BLM's view, if its decides that an effect is not significant, it does not have to review that issue under NEPA. That is wrong. Once it determines that a proposed action is a major federal action triggering NEPA, it must fully review all reasonably foreseeable effects, regardless of the level of predicted damage to the environment.

This is contrary to both NEPA and the APA which require that an agency's determinations be supported by factual information in the decision. "The agency must explicate fully its course of inquiry, its analysis and its reasoning." Dubois v. U.S. Department of Agriculture, 102 F.3d 1273, 1287 (1st Cir. 1996). An agency decision must always have a rational basis that is both stated in the written decision and demonstrated in the administrative record accompanying the decision. Kanawha & Hocking Coal & Coke Co., 112 IBLA 365, 368 (1990). The decision must be made in a "careful and systematic manner." Edward L. Johnson, 93 IBLA 391, 399 (1986). The record must demonstrate a "reasoned analysis of the factors involved, made in due regard for the public interest." Alvin R. Platz, 114 IBLA 8, 15-16 (1990). Where the BLM has made no analysis of the factors, then the decision is unreasonable.

Additional NEPA regulations, at 40 C.F.R. § 1502.22, impose three mandatory obligations on the BLM in the face of scientific uncertainty: (1) a duty to disclose the scientific uncertainty; (2) a duty to complete independent research and gather information if no adequate information exists (unless the costs are exorbitant or the means of obtaining the information are not known); and (3) a duty to evaluate the potential, reasonably foreseeable impacts in the absence of relevant information using a four-step process.

7-12

In the Marigold DEIS, the BLM has failed to meet the requirements of NEPA. If the BLM does not have sufficient information to complete the analysis, they should require its collection. The IBLA specifically rejected BLM's assertions made in an appeal regarding the Pipeline Deposit Mine that the BLM could not require sufficient information from the Project applicant.

> Finally, **insofar as BLM has determined that it lacks adequate information on *any* relevant aspect of a plan of operations, BLM not only has the authority to require the filing of supplemental information, it has the obligation to do so.** We emphatically reject any suggestion that BLM must limit its consideration of any aspect of a plan of operations to the information or data which a claimant chooses to provide.

Great Basin Mine Watch, 146 IBLA 248, 256 (1998)(emphasis added). Without complete information on air emissions, the DEIS is fatally flawed and cannot serve as a basis for Project approval.

**Minor questions and comments**

7-13 1. Is the area of the in-fill areas included in the disturbance? If not, please add this area to the disturbance or forbid the storage of things there.

2. We support the use of water from the Lone Tree Mine for processing to the maximum extent possible.

7-14 3. Are the shrub species to be used to dry the tailings expect to survive indefinitely?

7-15 4. The DEIS should disclose toxic release inventory information about this mine so that the public can adequately review the amount of toxic materials this mine has discharged to the environment.



7-13 The proposed infill areas have been included in the total disturbance estimates provided in text.

7-14 Results from reclamation studies that have been completed for part of the existing tailings impoundment indicate that shrubs establish easily and grow rapidly in the growth media and tailings used for reclamation. Therefore, it is anticipated that shrubs would continue to thrive in this environment on a long-term basis.

7-15 Toxic release inventory information for the Marigold Mine is submitted annually to the EPA and is available for review by the public upon request.

# Letter 7 Continued

In conclusion, the BLM should withdraw this DEIS and release a new one with alternative of no ancillary facilities on public land, including pit backfill alternative. The proposal should commit to backfilling pits to the extent possible. At an absolute minimum, backfill should be required to prevent the establishment of even ephemeral pit lakes since they may degrade groundwater or threaten avian health. Backfill will also avoid the land deposition of large amounts of heavy metals. We look forward to reviewing a revised plan.

Thank you for considering our comments.

Sincerely,

Tom Myers

Tom Myers, Ph.D.
Director

# Letter 7 Continued

# Responses to Letter 7

# Letter 8

**Mineral Policy Center**
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drandolph@mineralpolicy.org

Gerald Moritz, EIS Project Manager
Bureau of Land Management, Winnemucca Field Office
5100 E. Winnemucca Boulevard
Winnemucca, Nevada 89445

April 9, 2000

Dear Gerald Moritz,

These are the comments of Mineral Policy Center on the Marigold Mine Expansion Project Draft Environmental Impact Statement (DEIS). Mineral Policy Center (MPC) is a non-profit organization that works to reduce the negative fiscal, social, and environmental impacts of hard rock mining. We appreciate the opportunity to comment on this project.

Mineral Policy Center does not find the DEIS adequate at present. As outlined in the DEIS, MPC is forced to oppose the proposed action. Our primary concerns relate to the inadequate attention to heap leach, tailings and waste rock potential to degrade groundwater, and an uncertainty around the legality of the mine claims. All page references are from the DEIS unless otherwise stated.

Uncertainty related to the mine claims:

MPC questions the legality of some of the mine claims that would be utilized by the project, as those claims are outlined in the DEIS. On page 1-9 it states: "All GMMC mining claims are lode claims." A comparison of Maps 1-4 and 2-2 show that at least some of the lode claims are not planned to be mined.

8-1

Lode claims must meet several tests in order to be valid. There must be the discovery of an economically viable mineral deposit. The proper discovery of many of the lode claims is questioned. On page 3-51 the DEIS states: "Condemnation drilling indicates that no known geologic resources would be impacted by the proposed new and expanded waste rock dumps, new and expanded leach pad, and the new tailings impoundment." Further down on the same page it states: "Condemnation drilling is generally used to identify areas of *no potential economic value*...." (emphasis added) On page 3-52 it states: "Operations at the Marigold Mine under the Proposed Action are expected to remove *all mineral resources* that can be economically extracted under currently available technology and at the current and reasonable

# Responses to Letter 8

8-1 See response to Comment 7-2. In addition, Table 1-2 and Map 1-4 have been revised and Map 1-5 has been added to address the comment.

# Letter 8 Continued

foreseeable market prices for gold." (emphasis added) Based upon these statements in the DEIS, MPC questions the validity of the vast bulk of lode claims in the Project Area.

Claims COT 37 through COT 54, which are all those claims on the eastern half of T33N, R43E, Sec. 8; and claims RED 1823A through RED 1825A, are especially problematic. These claims, according to the DEIS, are to be utilized for waste rock piles or heap leach pads. As such, these claims will be made especially uneconomic for future mining. Lode claims are not valid merely to be utilized for ancillary purposes to the economic extraction of minerals from other claims. In addition, the holding of lode claims when it is known that there is no valuable mineral resources is not a "good faith" use of the Mine Law.

8-1

Mineral Policy Center requests that the validity of the mining claims held in the Project Area be fully explored.

Water Issues:

Tailings Impoundment:

The DEIS acknowledges a current tailings impoundment leak which is causing a groundwater pollution plume (pg.2-19). Map 3-3 shows the location of monitoring wells and tailings dam piezometers. The only shown wells are located to the north of the tailings dam. From the information given, it is unclear whether the full leakage from the tailings is known. What appears to be known is where the leakage plume has extended beyond the footprint of the tailings piles themselves. What appears to be lacking is any knowledge of whether there is leakage from elsewhere in the tailings impoundment which has not extended beyond the impoundment footprint. There are no monitoring wells shown which extend through the tailings into the underlying vadose zone or groundwater. MPC finds it inadequate that the only leak detection wells for the tailings impoundment are located beyond the footprint of the impoundment itself. There must be a much more inclusive set of monitoring wells that will more fully capture the possible locations and extents of other tailings impoundment leaks.

8-2

The proposed action includes the construction of a new tailings impoundment, which would be constructed to the same standards as the existing facility (pg. 2-20), except for the inclusion of an unspecified leak detection system. Given the failure of the current tailings facility, the leak detection system must be fully explained in the EIS prior to any approval in order to allow the public and the BLM to evaluate the proposal. The current wording is so vague that it is not acceptable. The current tailings impoundment was built to the State of Nevada requirements, yet due to the current leak, the public has no reason to be assured that the groundwater will be protected by these standards.

Should the new tailings impoundment not be built, and the existing tailings impoundment be utilized for the additional tailings, it is necessary to complete a much fuller groundwater monitoring program than is currently in place. The existing monitoring wells do not adequately cover the area overlain by the tailings. There must be wells dug and completed in the underlying vadose zone and alluvial aquifer directly below the tailings impoundment. Such a monitoring plan must be fully developed and released to the public for evaluation prior to the permitting of any new tailings additions onto the existing impoundment.

Waste Rock:

8-3

On page 3-23 it is acknowledged that tailings leakage has reached the alluvial groundwater. Despite this, the DEIS relies upon the depth to groundwater to minimize the

# Responses to Letter 8

8-2 See responses to Comments 6-1 and 7-5.

8-3 See responses to Comments 6-2 and 7-10. Although seepage from the waste rock dumps is possible after major storm events, seepage is expected to be minor and limited to surface seeps at the base of the waste rock dumps. These surface seeps would dry up quickly and not present a hazard to wildlife.

potential for waste rock seepage to degrade groundwater (pg. 3-28). The reliance upon depth to groundwater to mitigate against seepage of poor quality water from any mine facilities to groundwater is not acceptable. Seepage of poor quality water has the clear possibility of reaching groundwater at some point in the future should such seepage occur. The depth to groundwater merely delays the time at which this may occur, lessening the potential that monitoring will be occurring, that the responsible parties will be available to remediate the damage, and that the public will not suffer either through a degraded environment or through an economic burden of remediation.

8-3 The current waste rock closure plan is inadequate. Six inches of run-of-the-mine material does not constitute a cap. Since it is acknowledged that most of the waste rock material has the potential to degrade water quality due to elevated levels of arsenic, mercury, and molybdenum (pg. 3-28), there must be a fully developed plan to prevent any seepage. The EIS must explore the full extent of seepage that may occur rather than rely upon vague statements to minimize the potential. Should the water that lands on the waste rock piles seep into and through them, what load of metals would leach out of them into the underlying vadose zone and potentially to the alluvial groundwater? What is the seepage through a six-inch layer of run-of-the-mine material? An adequate evapotranspiration cover must be developed and released to the public for evaluation prior to any permitting.

Solution ponds/Collection System:

On page 2-17 it is acknowledged that a pregnant solution leak has occurred. The extent of the leak is not given, and must be included in the EIS. The DEIS states: "this leakage has been contained to prevent off-site contamination." (pg. 2-17). Since the site is many hundreds of acres, this statement is meaningless as to the danger to groundwater quality. We assume the

8-4 leakage is minor, but such an assumption is not well founded given the lack of explanation in the DEIS.

Given the failure of the current pregnant solution system, and the lack of information regarding the failure, the reliance upon it for the proposed action is unwise. A full explanation of how future actions will prevent leaks that current actions have permitted must be included in the EIS.

Heap Leach Pads:

The heap leach material is acknowledged to generate arsenic and mercury (pg. 3-28). As such, the closure plan is inadequate. There are three methods of closure discussed in the DEIS (pg. 2-35 and 36).

8-5 The first method, fresh water rinse with chemical neutralization and/or carbon filtration, does not include explicit description of heap drainage management post closure. The lack of discussion implies that there is no management other than drainage to the ground. Due to the presence of toxic materials in the seepage water, there must be some management of these waters other than drainage to the ground. The EIS must include the quantities of toxins that will seep out of the closed heap, and their management. Again, depth to groundwater is not sufficient to insure protection of groundwater from contamination. There is no discussion of any heap cap in this option.

The second method, expanded rinse with bacterial neutralization and a passive bioreactor, also fails to include any capping.



8-4 See response to Comment 2-12.

8-5 See responses to Comments 2-16 and 2-17.

# Letter 8 Continued

8-5 The third method, the Greenworld Science Method, does include a 6-inch evapotranspiration cover. An evapotranspiration cover must be capable of absorbing all the water that falls on it as rain or that melts into it from snow melt, without seepage through the cover to the underlying materials, and then hold a diverse enough plant community to fully transpire that moisture latter. Such a cover is much greater in depth than 6-inches. A proper heap cap must also include a layer beneath the plant growth layer that is functionally impermeable to water, such as a geomembrane or compacted clay layer. Such a cap must be included in any closure plan.

The third method also explicitly includes the land application of drain down solutions. There must be a full explanation of what materials would be in the solution, in quantities related to the full history of the closed heap.

8-6 Open Pits:

The DEIS failed to evaluate the potential for the pits to act as sources for groundwater contamination. Since the material coming out of the pits is acknowledged to leach toxic materials. it is assumed the pit walls and excess rock in them will as well. The EIS must include the potential for pits to act as sources for groundwater pollution, as well as a management plan that will prevent such contamination.

8-7 Scope of Analysis:

The scope of alternatives analyzed is inadequate.

The complete backfill option must be fully evaluated. The DEIS on page 2-46 gives no adequate explanation for the elimination of this alternative.

An alternative that includes partial backfill of the East Hill Pit, the Red Rock and Top Zone Pits, in addition to the 8-south Pit must be included. Such an alternative would conceivably reduce the size of waste rock piles, reduce the visual scars, and lessen the potential for pit wall slumpage.

Cultural Issues:

Mineral Policy Center hereby defers to, and supports, the comments of the Western Shoshone Defense Project concerning cultural issues.

8-8 8-South Pit Lake:

On pages 3-31, 32 the DEIS says that "no hydrologic studies have been conducted to determine the potential impacts of a lake in the 8-South Pit." As such the DEIS is incomplete. Such a study must be done and must be open to public evaluation and comment. Also, since such a study has not been conducted, the statements that follow on page 3-32 to the effect that groundwater flow would be minimal are unfounded.

Due to the acknowledged discrepancy with the groundwater model conducted for the Lone Tree Mine (pg. 3-25) there must be a complete groundwater hydrological study of the area, and it must be open to review by the public prior to any permitting.

* Please see additional comments

# Responses to Letter 8

8-6 Text was added to Section 3.1.2.1, Proposed Action – Groundwater, to address the potential infiltration of meteoric water with elevated metals to groundwater for the 5-North and 8-North pits. A mitigation measure was added to Section 3.1.4, Potential Mitigation/Monitoring, that would require the installation of monitoring wells downgradient of the proposed 5-North and 8-North pits.

8-7 See responses to Comments 2-2 and 2-4.

8-8 See responses to Comments 1-8, 1-11, and 2-10.

Conclusions:

As currently outlined in the DEIS, Mineral Policy Center must oppose the permitting of the proposed project. The DEIS must be significantly expanded in a number of important areas, and in light of this we urge the release of a new DEIS after the larger insufficiencies are met. Thank you, again, for the opportunity to comment. If you have any questions, please feel free to contact me at (970) 382-0421.

Respectfully,

Dan Randolph

Dan Randolph
Southwest Circuit Rider

* Additional Comments:

Air Quality:

It is unclear what base was used to calculate the max. 24 hr. PM10 expected due to the proped Action. The maximum daily background must be added to the maximum daily projected increase,

8-9

What are the sources of mercury, and what quantity of mercury release to the air is expected.

There needs to be a discussion of PM 2.5.



8-9 Maximum 24-hr $PM_{10}$ impacts are expected to be similar to those highest values measured in the past, since planned production from the mine is essentially unchanged. Under the Proposed Action, there would be additional disturbance that could potentially contribute to increases in fugitive dust emissions from the facilities. These impacts are discussed in Section 3.3.2, Environmental Consequences, and Section 3.3.3, Cumulative Impacts. Mercury sources are listed in the response to Comment 1-13. See response to Comment 7-12 for a brief discussion of the status of $PM_{2.5}$ as an air quality standard.

# Letter 8 Continued

# Responses to Letter 8

# Letter 9


# SIERRA CLUB

California/Nevada RCC Mining Committee
P.O. Drawer W, Independence, CA 93526
Stan Haye, Chair. (619) 878-2411, x2306


4/8/99

Bureau of Land Management
Winnemucca Field Office
5100 E. Winnemucca Blvd
Winnemucca, NV 89445
Attn: Gerald Moritz

Re: Marigold Mine Expansion

Dear Sir:

In regard to this project, I have two questions.

9-1 1. Considering that 8 pits are proposed, why is no sequential backfill proposed? It would seem that with a little foresight, it would be cost effective to backfill some of the pits, thus easily improving the quality of the reclamation in a cost effective way.

9-2 2. The project is located on both private and public land. Some of the project facilities, such as heap leach piles, waste rock piles, tailings ponds and other facilities are on lode claims on public land. This is illegal, since if the lode claims are made unavailable for mining, they must not have a valid discovery and must be invalid. *All* facilities should be legally located on millsites on public land or on private land.

Thank you for your attention to these matters. Please keep me informed as to the action on this matter.

Sincerely,

Stan Haye

Stan Haye
Chair

To explore, enjoy, and protect the wild places of the earth. . .

# Responses to Letter 9

9-1 See response to Comment 2-4.

9-2 See response to Comment 7-2.


9-2 See response to Comment 7-2.

# Letter 10

**Newmont Mining Corporation**

Land Department
661 W. 6th Street
Winnemucca, NV 89445
(775) 625-5621
Fax (775) 625-5655

March 15, 2000

Mr. Gerald Moritz
EIS Project Manager
Bureau of Land Management
Winnemucca Field Office
5100 East Winnemucca Blvd.
Winnemucca, NV 89445

Re: Draft Environmental Impact Statement Marigold Mine Expansion Project

Mr. Moritz:

In reviewing the subject document, there appear to be a few errors in the property described in Table 1-2.

Entry number four which lists:

| Name Of Claim | BLM Serial Number | Owner | Owned/ Leased | Location |
|---|---|---|---|---|
| Private | N/A | Newmont Gold Corporation | Leased | T33N, R43E, Sec 5, 6, 7, 13, 25, 31 |

Should be corrected to read:

| Name Of Claim | BLM Serial Number | Owner | Owned/ Leased | Location |
|---|---|---|---|---|
| Private | N/A | Newmont Gold Company | Leased | T33N, R43E, Sec 5, 6, 7, 9, ~~13~~, 17, ~~25~~, 31<br>T33N, R42E, Sec 13, 25 |

10-1

Entry number five which lists:

| Name Of Claim | BLM Serial Number | Owner | Owned/ Leased | Location |
|---|---|---|---|---|
| Private | N/A | Newmont Gold Corporation | Leased | T34N, R43E, Sec 13, 29, 31, 33 |

Should be corrected to read:

| Name Of Claim | BLM Serial Number | Owner | Owned/ Leased | Location |
|---|---|---|---|---|
| Private | N/A | Newmont Gold Company | Leased | T34N, R43E, Sec ~~13~~ 19, 29, 31, 33 |

Letter 10 Continued

# Responses to Letter 10

10-1 Table 1-2 has been revised according to the information provided in the comment.

# Letter 10 Continued



10-1

In addition, entries number nine and 11 where Roby Exploration Company is listed as owner to T33N, R43E, Sec 9 and T33N, R43E, Sec 17, respectively, should both be corrected to indicate that this is surface ownership only. As indicated by the corrections above, both of these sections are subject to a lease from Newmont Gold Company to Roby Exploration Company.

Entry number 18 erroneously lists "Roby Exploration Company" under the Owner column and "Newmont Owned" under the Owned/Leased column for T33N, R43E, Sec 31. This section is accounted for above and this entry should be eliminated.

Please let me know if you have any questions in this regard.

Sincerely,

Thomas M. Roesch
Regional Landman

c: R. Bryson - Roby Exploration Company
D. Faley
M. Jones
R. Moorhead

# 5.0 LIST OF PREPARERS AND REVIEWERS

## 5.1 Bureau of Land Management EIS Team

| Discipline | Name | BLM Office Location |
|---|---|---|
| Project Manager/NEPA/Air Quality/Social and Economic Values | Gerald Moritz[1] | Winnemucca |
| Assistant Project Manager/Geology and Minerals | Jeff D. Johnson | Winnemucca |
| Water Resources/Geochemistry | Craig Drake | Winnemucca |
| | Tom Olsen | Reno |
| Soils/Vegetation Resources/Special Status Plants | Michael Zielinski | Winnemucca |
| Wildlife and Fisheries Resources/Special Status Wildlife | Duane Crimmins | Battle Mountain |
| Range Resources | Steve Bell | Battle Mountain |
| Land Use and Access | Ken Detweiler | Winnemucca |
| Recreation | Barb Kelleher | Winnemucca |
| Aesthetics | Mike Bilbo | Winnemucca |
| Hazardous Materials | Steve Brooks | Winnemucca |
| Cultural Resources/ Ethnography/Paleontology | Regina Smith | Winnemucca |

[1]Gerald Moritz ended his role as project manager effective July 2000. Jeff Johnson assumed the project manager role at that time.

## 5.2 ENSR EIS Team

| Discipline | Name | Degree(s) and Experience |
|---|---|---|
| Project Manager | Phil Hackney | B.S. Botany<br>24 years experience |
| NEPA Document Review | Valerie Randall | B.A. Urban Studies<br>21 years experience |
| Assistant Project Manager/ Vegetation Resources/Range Resources/Special Status Plants | Jon Alstad | M.S. Range Science;<br>B.S. Animal Science;<br>A.A. Liberal Arts;<br>11 years experience |
| Groundwater and Geochemistry/Geology and Minerals | Bob Berry | Ph.D. Geochemistry<br>B.S. Geology<br>Prof. Degree Hydrogeology<br>21 years experience |
| Surface Water/Soils | Jim Burrell<br>(Riverside Technology, inc.) | M.S. Civil Engineering<br>B.S. Forest Management<br>18 years experience |
| Air Quality | Vince Scheetz | M.S. Systems Management<br>B.S. Mathematics<br>24 years experience |
| Wildlife and Fisheries Resources/Special Status Wildlife Species | Lori Nielsen | B.S. Wildlife Ecology/ Management;<br>14 years experience |
| Land Use and Access/ Recreation/Aesthetics | Randy Rasmussen | M.S. Natural Resources, Recreation, Tourism<br>B.S. Physical Geography<br>10 years experience |
| Aesthetics (Visual Simulations) | Craig Taggart<br>(EDAW, Inc.) | MLA Landscape Architecture<br>B.S. Zoology<br>24 years experience |
| Social and Economic Values | Debbie Eley | M.S. Forestry<br>B.A. Economics<br>6 years experience |
| Hazardous Materials | Dan Gregory | M.S. Geology<br>B.A. Geology<br>18 years experience |
| Cultural Resources/Paleontology | Karen Caddis-Burrell | B.A. Geography/Anthropology/ Journalism<br>B.S. Resource Management<br>16 years experience |

**5.2 ENSR EIS Team (Continued)**

| Discipline | Name | Degree(s) and Experience |
|---|---|---|
| Ethnography/Native American Consultation | Kim Munson | M.A. Cultural Anthropology<br>B.A. Cultural Anthropology and Archaeology<br>5 years experience |
| | Polly Quick<br>(International Technology Corporation) | Ph.D. Anthropology<br>M.A. Anthropology<br>B.A. Anthropology<br>22 years Experience |
| AutoCAD/EIS Maps | Ana Vargo<br>(ESA Consultants, Inc.) | M.S. Geology<br>B.S. Geology<br>8 years experience |
| Document Production/Coordination | Sue Coughenour | 16 years experience |

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# ABBREVIATIONS

| | |
|---|---|
| µm | micrometers |
| µg/m$^3$ | micrograms per cubic meter |
| ABA | acid-base accounting |
| AGP | acid generating potential |
| AIRFA | American Indian Religious Freedom Act of 1978 |
| amsl | above mean sea level |
| ANP | acid neutralizing potential |
| APE | Area of Potential Effect |
| AUM | animal unit month |
| BLM | Bureau of Land Management |
| BMP | Best Management Practices |
| BP | before present |
| CEQ | Council on Environmental Quality |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| cfs | cubic feet per second |
| cm/s | centimeters per second |
| CO | carbon monoxide |
| EIS | environmental impact statement |
| °F | degrees Fahrenheit |
| FLPMA | Federal Land Policy and Management Act of 1976 |
| gpm | gallons per minute |
| HAP | hazardous air pollutant |
| HCI | Hydrologic Consultants, Inc. |
| HDPE | high density polyethylene |
| I-80 | Interstate 80 |
| IM | Instruction Memorandum |
| KOP | Key Observation Point |
| kV | kilovolts |
| mg/l | milligrams per liter |
| mgd | million gallons per day |
| MMC | Marigold Mining Company |
| MSDS | Material Safety Data Sheets |
| MSHA | Mine Safety and Health Administration |
| MWMP | Meteoric Water Mobility Procedure |
| NAAQS | National Ambient Air Quality Standards |
| NAGPRA | Native American Grave Protection and Repatriation Act of 1990 |
| NDEP | Nevada Department of Environmental protection |
| NDOW | Nevada Division of Wildlife |
| NEPA | National Environmental Policy Act |
| NHPA | National Historic Preservation Act of 1986 |
| NNP | net neutralizing potential |
| $NO_2$ | oxides of nitrogen |

| | |
|---|---|
| NOAA | National Oceanographic and Atmospheric Administration |
| NOI | Notice of Intent |
| NP | neutralizing potential |
| NRCS | Natural Resources Conservation Service |
| NRHP | National Register of Historic Places |
| NRS | Nevada Revised Statute |
| $PM_{10}$ | particulate matter with an aerodynamic diameter of 10 microns or less |
| POO | Plan of Operations |
| PSD | Prevention of Significant Deterioration |
| RFFA | reasonably foreseeable future action |
| ROW | right-of-way |
| SARA | Superfund Amendments and Reauthorization Act |
| SHPO | State Historic Preservation Officer |
| $SO_2$ | sulfur dioxide |
| SPPCo | Sierra Pacific Power Company |
| SVP | Society of Vertebrate Paleontology |
| TCLP | Toxicity Characterization Leaching Procedure |
| TDS | total dissolved solids |
| T/kT | tons/kiloton |
| tpy | tons per year |
| TSP | total suspended particulate |
| USCOE | U.S. Army Corps of Engineers |
| USDOT | U.S. Department of Transportation |
| USEPA | U.S. Environmental Protection Agency |
| USFWS | U.S. Fish and Wildlife Service |
| VOC | volatile organic compound |
| VRM | Visual Resource Management |
| WAD | weak acid dissociable |
| WMC | Water Management Consultants |
| WSA | Wilderness Study Area |

# GLOSSARY

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| Alluvium | A general term for all detrital deposits resulting from the operations of modern rivers, including the sediments laid down in riverbeds, floodplains, lakes, and fans at the foot of mountain slopes and estuaries. |
| Ambient (air) | The surrounding atmospheric conditions. |
| Aquifer | A stratum of permeable rock, sand, etc, which contains water. Water source for a well. |
| Archaeology | The science that investigates the history of peoples by the remains belonging to the earlier periods of their existence. |
| Artifact | Any object showing human workmanship or modification especially from a prehistoric or historic culture. |
| Attenuate | To lessen, decrease, reduce a concentration. |
| Clean Water Act | Federal Water Pollution Control Act, as amended. |
| Contrast | The effect of a striking difference in the form, line, color, or texture of an area being viewed. |
| Cultural resources | Any site or artifact associated with cultural activities. |
| Endangered species | Any species in danger of extinction throughout all or a significant portion of its range. This definition excludes species of insects that the Secretary of the Interior determines to be pests and whose protection under the Endangered Species Act of 1973 would present an overwhelming and overriding risk to man. |
| Environment | The surrounding conditions, influences, or forces that affect or modify an organism or an ecological community and ultimately determine its form and survival. |
| Erosion | The group of processes whereby earth or rock material is loosened or dissolved and removed from any part of the earth's surface. |
| Fault | A fracture or fracture zone along which there has been displacement of the sides relative to one another parallel to the fracture. |
| Floodplain | That portion of a river valley, adjacent to the river channel, built of sediments and inundated with water at least once every 100 years. |
| Geology | The science that relates to the earth, the rocks of which it is composed, and the changes that the earth has undergone or is undergoing. |

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| Habitat | A specific set of physical conditions that surround a single species, a group of species, or a large community. In wildlife management, the major components of habitat are considered to be food, water, cover, and living space. |
| Historic context. | Planning document that is used as a cultural resources management tool. It groups information about related important cultural resources based on a specific theme, geographic limits, and chronology with the purpose of providing subsequent identification and framework for evaluation of the eligibility or significance of resources located at a later time in the same area. Historic contexts aid in planning and evaluating future cultural research. |
| Hydraulic Conductivity | The rate at which a porous medium can transmit water (units of length/time). |
| Hydrology | The science that relates to the water of the earth. |
| Impact | A modification in the status of the environment brought about by the Proposed Action. |
| Intrusive rock | Igneous rock formed within surrounding rock as a result of magma intrusion. |
| Jurisdictional waters | Areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. |
| Landform | A term used to describe the many types of land surfaces that exist as the result of geologic activity and weathering, e.g., plateaus, mountains, plains, and valleys. |
| Mil | 1/1000 inch |
| Mineralization | Process by which minerals are introduced into a rock, resulting in an economically valuable or potentially valuable deposit. |
| One-hundred-year flood | A flood with a magnitude that may occur once every 100 years. A 1-in-100 chance of a certain area being inundated during any year. |
| Paleontology | The science that deals with the life of past geological ages through the study of the fossil remains of organisms. |
| Paleozoic | Span of time from end of Precambrian to beginning of Mesozoic ranging from about 570 million to 250 million years ago. |
| Particulate(s) | Minute, separate particles, such as dust or other air pollutants. |
| pH | The measure of acidity or basicity of a solution. |

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| Physiographic province | Region in which all parts have similar geologic structure and climate and whose landforms differ significantly from those of other regions. |
| Project Area | The area in the immediate vicinity of the Marigold Mine Expansion Project. |
| Raptor | A bird of prey. |
| Region | A large tract of land generally recognized as having similar character types and physiographic types. |
| Right-of-way | Strip of land over which the powerline, access road, or maintenance road would pass. |
| Riparian area | A form of wetland transition between permanently saturated wetlands and upland areas. These areas exhibit vegetation or physical characteristics reflective of permanent surface or subsurface water influence. Lands along, adjacent to, or contiguous with perennially and intermittently flowing rivers and streams, glacial potholes, and the shores of lakes and reservoirs with stable water levels are typical riparian areas. Excluded are such sites as ephemeral streams or washes that do not exhibit the presence of vegetation dependent upon free water in the soil. |
| Sedimentary rock | Rock resulting from consolidation of loose sediment that has accumulated in layers. |
| Seismicity | The likelihood of an area being subjected to earthquakes. The phenomenon of earth movements. |
| Species | A group of individuals of common ancestry that closely resemble each other structurally and physiologically and in nature interbreed producing fertile offspring. |
| Stratigraphy | Form, arrangement, geographic distribution, chronologic succession, classification, and relationships of rock strata. |
| Tectonics | Large-scale structural features of the upper part of the earth's crust. |
| Tertiary | Span of time between 65 and 3 to 2 million years ago. |
| Threatened species | Any species likely to become endangered within the foreseeable future throughout all or a significant part of its range. |
| Transmission line | An electric power line operating at a voltage of 69 kilovolts or greater. |
| Transmissivity | A measure of the amount of water that can be transmitted horizontally by a porous medium (units of length2/time). |
| Uplift | Structurally high area in the crust produced by an upthrust of rocks. |

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| Visual Resource Management | Classification of landscapes according to the kinds of classesof structures and changes that are acceptable to meet established visual goals (BLM designation). |
| Wetlands | Areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. BLM Manual 1737, Riparian-Wetland Area Management, includes marshes, shallow swamps, lakeshores, bogs, muskegs, wet meadows, estuaries, and riparian areas as wetlands. |
| Wind rose | A wind rose is a graphical representation of wind direction and wind speed frequencies. |

# INDEX

5-North Heap Leach Pad ..... 2-17, 2-19, 2-22, 2-23, 2-31; 3-76, 3-78, 3-122, 3-123
5-North Pit ..... iii; 2-7, 2-10, 2-15, 2-16, 2-17, 2-22, 2-24, 2-42, 2-50; 3-6, 3-9, 3-20, 3-28, ..... 3-49, 3-54; 3-76, 3-78, 3-114, 3-122
5-North Waste Rock Dump ..... 2-16, 2-40, 2-41, 2-49; 3-32, 3-76, 3-78, 3-122, 3-124
8-North Pit ..... i, ii; 2-1, 2-7, 2-10, 2-15, 2-22, 2-24, 2-28, 2-41, 2-50; 3-5, 3-9, 3-28, 3-35 ..... 3-37, 3-49, 3-53, 3-64, 3-76, 3-78, 3-94
8-North Waste Rock Dump ..... i; 2-16, 2-42, 2-50; 3-32, 3-35, 3-76, 3-78, 3-80, 3-115, 3-122, 3-124, 3-173
Aesthetics ..... iv; 3-93, 3-118, 3-175
Air Quality ..... iii; 1-1, 1-12; 2-30; 3-1, 3-56, 3-57, 3-61, 3-62, 3-63, 3-65, 3-66, 3-170, 3-171, 3-175
Alternatives Considered but Eliminated from Detailed Analysis ..... 2-40
Ancillary Facilities ..... 1-7; 2-40
Cultural Resources ..... i, vi; 3-119, 3-151, 3-153, 3-158, 3-167, 3-173, 3-175
Emergency Response ..... 2-27; 3-147, 3-150, 3-171
Environmental Protection Measures and Monitoring ..... 2-16, 2-28
Ethnography ..... vi; 3-119, 3-151, 3-162; 4-2
Geochemistry ..... ii; 3-2, 3-28, 3-35, 3-84, 3-91, 3-94, 3-175
Geology and Minerals ..... 3-1, 3-36, 3-37, 3-166
Hazardous Materials ..... 1-12; 2-25, 2-26, 2-27; 3-1, 3-145, 3-146, 3-150, 3-171, 3-175
Interrelated Projects ..... 2-50, 2-53; 3-125
Land Use and Access ..... 3-110, 3-117, 3-175
Mining Operations ..... 2-7
Native American Concerns ..... 3-169, 3-173, 3-174
No Action Alternative ..... i; 2-41, 2-48, 2-49, 2-54, 2-55; 3-1, 3-35, 3-50, 3-66, 3-80, 3-88, 3-94, 3-103, ..... 3-108, 3-116, 3-117, 3-125, 3-142, 3-150, 3-173
Noise ..... vi; 3-121 3-124 3-125
Old Marigold Waste Rock Dump Expansion ..... 3-76
Paleontology ..... vi; 3-1, 3-119, 3-151, 3-165, 3-172, 3-173, 3-175
Proposed Action ..... i, vi; 1-4, 1-8, 1-9; 2-1, 2-2, 2-5, 2-7, 2-10, 2-16, 2-17, 2-19, 2-21, 2-22, 2-23, 2-24, 2-25, 2-27 ..... 2-28, 2-29, 2-30, 2-31, 2-33, 2-35, 2-36, 2-41, 2-50, 2-52, 2-53, 2-55; 3-1, 3-28 3-34 ..... 3-35 3-36 3-37 3-38 3-49, 3-50, 3-51, 3-55, 3-62, 3-66, 3-67, 3-75, 3-76, 3-77, 3-80, 3-81 ..... 3-84, 3-88, 3-89, 3-91, 3-94, 3-95, 3-101, 3-102, 3-108, 3-109, 3-114, 3-115 ..... 3-116, 3-117, 3-121, 3-122, 3-124, 3-125, 3-138, 3-139, 3-141, 3-142, 3-149, 3-150 ..... 3-153, 3-155, 3-167, 3-168, 3-169, 3-171, 3-173, 3-175, 3-176
Purpose of and Need for the Proposed Action ..... 1-8
Range Resources ..... v; 3-1, 3-82, 3-104, 3-110, 3-114, 3-116, 3-175
Reclamation ..... i, iv; 1-1, 1-4, 1-7, 1-12; 2-1, 2-10, 2-17, 2-28, 2-29, 2-31, 2-35, 2-36, 2-38; 3-68, 3-70 ..... 3-84, 3-88, 3-95, 3-123, 3-124, 3-138, 3-139, 3-140, 3-141, 3-147, 3-169, 3-171; 4-1, 4-3
Recreation ..... 3-1, 3-110, 3-114, 3-116, 3-117, 3-175; 4-4
Red Rock Pit Expansion ..... 3-76, 3-78
Resort Waste Rock Dump Expansion ..... 3-76
Roads ..... 2-2, 2-15, 2-24, 2-40; 3-63
Security and Fencing ..... 2-24; 3-114
Social and Economic Values ..... 3-93, 3-126, 3-175

Soils ..... v; 3-1, 3-67, 3-71, 3-74, 3-82, 3-175
Special Status Species ..... 3-1, 3-89, 3-90, 3-91, 3-96
Spill Prevention ..... 2-27, 2-28; 3-147
Storm Water Control ..... 2-22
Tailings Impoundment ..... 1-7; 2-2, 2-10, 2-21, 2-39; 3-24, 3-32, 3-64
Top Zone Pit Expansion ..... 3-76, 3-78
Trout Creek Diversion ..... 3-34
Vegetation Resources ..... iii; 3-1, 3-83, 3-89
Visual Resources ..... 3-118, 3-121
Waste Management ..... 2-27, 2-28; 3-28, 3-133
Waste Rock Dumps ..... 1-7; 2-2, 2-15, 2-37
Water Resources ..... ii; 1-12; 2-10; 3-1, 3-2, 3-9, 3-84, 3-91, 3-94, 3-175 4-3
Water Supply ..... 2-2, 2-23, 2-24; 3-133
Wildlife and Fisheries Resources ..... iv; 3-1, 3-89, 3-117, 3-175
Work Force and Schedule ..... 2-7

# APPENDIX A

# BLM'S HEAP LEACH CLOSURE POLICY AND GUIDELINES

# United States Department of the Interior

## BUREAU OF LAND MANAGEMENT

Nevada State Office
P.O. Box 12000
Reno, Nevada 89520-0006

IN REPLY REFER TO:
3000 (NV-920) P

August 3, 2000

EMS Transmission 8/03/00
Instruction Memorandum No. NV-2000-066
Expires 9/30/2001

To: Field Managers, Nevada
Deputy State Directors and Staff Chiefs, NSO

From: Associate State Director, Nevada

Subject: Nevada Bureau of Land Management's Reclamation/Closure Policy for Water Management for Hardrock Mining Activities

ISSUE: A number of mining operations that were originally permitted in the 1980's have or are preparing to cease mining operations. Several Bureau of Land Management (BLM) field offices have raised issues concerning closure or final reclamation procedures under the Surface Management Regulations (43 CFR 3809) for these operations. The issues range from the adequacy of the original National Environmental Policy Act (NEPA) compliance documentation to specific technical issues such as land application of heap drain down.

Under the guidance of the Nevada BLM State Leadership Team, a task force was formed to address these issues, including formulate policy and develop a guidance document. Make up of the task force included field and state office specialists and managers.

The policy and guidance document was prepared in coordination with the Federal and State regulatory and land managing agencies. In addition, input was solicited from interest groups, including mining interests and environmental groups.

POLICY: It is the policy of the Nevada BLM that reclamation, including closure, of hardrock mining operations be conducted and completed in a proper manner to ensure the protection of the public lands under BLM jurisdiction. It is the responsibility of the BLM to protect the long-term health of the public lands. Authorization to allow the release of contaminated waters into the environment must be in compliance with the Clean Water Act, Safe Drinking Water Act, Nevada Groundwater Protection Act, Endangered Species Act, other applicable environmental laws, and consistent with BLM's multiple use and resource protection responsibilities under the Federal Land Policy and Management Act (FLPMA).

It is the policy of the Nevada BLM that all modifications to an approved Plan of Operations regarding closure will be reviewed and approved by the authorized officer under 43 CFR 3809. Any Federal decision to approve a modification to an approved Plan of Operations, including changes to the closure plan, must be in compliance with the requirements of NEPA.

It is the policy of the Nevada BLM to coordinate and collaborate to the fullest extent practical with the State regulatory agencies responsible for the permitting and oversight of mine reclamation and closure activities. Where appropriate, the BLM will utilize the State environmental regulatory requirements, guidance and standards as the base for its analyses and reviews. The BLM recognizes the State's authority under the Clean Water Act, Safe Drinking Water Act, and Nevada Groundwater Protection Act and in carrying out its responsibilities under FLPMA will rely on the State's decisions pursuant to that authority.

IMPLEMENTATION: The "Nevada Bureau of Land Management's Guidance for Hardrock Mining Reclamation/Closure Activities - Management of Heap Leach Effluents -" (attached) is intended as a guide in meeting the requirements of this policy. Specifically the attached document provides guidance to the BLM in meeting its responsibilities to ensure the evaluation and analysis of potential impacts to surface waters, groundwaters and unsaturated zones. The appropriateness of the individual discussions will depend on the issues being addressed and the decisions being made.

CONTACT PERSON: Questions concerning this policy and the attached guidance document should be directed to Dr. Tom Olsen, BLM Nevada State Office, Division of Minerals Management at
775-861-6451.

Signed by:
Jean Rivers-Council
Associate State Director

Authenticated by:
Pam Collins
Staff Assistant

1 Attachment
1 - Nevada Bureau of Land Management's Guidance for Hardrock Mining Reclamation/Closure Activities - Management of Heap Leach Effluents (15 pp)

# Nevada Bureau of Land Management's Guidance for Hardrock Mining Reclamation/Closure Activities - Management of Heap Leach Effluents -

## INTRODUCTION

The Bureau of Land Management (BLM) is responsible for management of public lands and resources for present and future generations under our statutory mandates. BLM is committed to close coordination and working through State and local regulators and their statutory primacy requirements to meet our Federal statutory and resource management objectives. BLM has the responsibility to ensure reclamation, including closure, of hardrock mining operations on BLM-administered lands is conducted and does not result in unnecessary or undue degradation of the public lands. This responsibility includes understanding technical issues associated with the closure of hardrock mining operations and making informed decisions. This guidance document is intended to facilitate Nevada BLM field offices in carrying out their responsibilities, ensuring coordination with the appropriate State regulatory agencies.

There are four main topics covered in this guidance document.

- When faced with hardrock mining reclamation, including closure, the authorized officer must ensure decisions will not result in unnecessary or undue degradation of the public lands. All actions must comply with the appropriate federal and state laws, and consistent with BLM's multiple use responsibilities under the Federal Land Policy and Management Act (FLPMA).

- Reclamation decisions need to be coordinated and made in collaboration with the State regulatory agencies responsible for the permitting and oversight of mine reclamation, including closure activities.

- The BLM must ensure that adequate financial guarantees are in-place for mining operations on public lands which will include reasonably foreseeable reclamation costs, including closure and monitoring, on BLM-administered lands.

- The BLM field specialists and managers need to understand and consider all the technical issues associated with hardrock mine reclamation, including closure activities and the long-term implications of closure, while ensuring that reclamation, including closure activities, is conducted in a timely and effective manner.

Specific technical issues addressed in this guide are disposal and monitoring of heap detoxification waters, heap drain-down waters and process pond sludge.

## CLOSURE

In this guidance document, the term "closure" refers to the act of closing any phase of a mining operation where further operations are not intended. It is the final step of reclamation in closing down a mining operation or any phase of an operation.

It is important to be aware of the different usage of the term "closure" by the Nevada Division of Environmental Protection (NDEP), Bureau of Mining Regulation and Reclamation (BMRR). As used by BMRR, closure is when chemical stabilization of a mine site has been achieved after mining activity ceases. State closure requirements primarily deal with stabilization of process and non-process components, solid and liquid process mine waste, pits, waste rock dumps, ore stockpiles, and any other associated mine components that, if not properly managed during operation and closure, could potentially lead to the degradation of the environment.

## AUTHORITY, ANALYSES AND DECISIONS

All surface management activities, including reclamation, must comply with all pertinent Federal laws and regulations, and all applicable State environmental laws and regulations. The fundamental requirement, implemented in 43 CFR 3809, is that all hardrock mining under Plan of Operations or Notice on the public lands must prevent unnecessary or undue degradation. The Plan of Operations and any modifications to the approved Plan of Operations must meet the requirement to prevent unnecessary or undue degradation. Authorization to allow the release of effluents into the environment must be in compliance with the Clean Water Act, Safe Drinking Water Act, Endangered Species Act, other applicable Federal and State environmental laws, consistent with BLM's multiple use responsibilities under the Federal Land Policy and Management Act and fully reviewed in the appropriate National Environmental Policy Act (NEPA) document.

The BLM should ensure reclamation issues, including closure, are adequately addressed as part of the initial Plan of Operations. However, it needs to be recognized that proposed reclamation activities found in the original Plan of Operations are subject to change and are likely to change. With mine development, more detailed hydrologic, geologic and chemical information and actual monitoring data becomes available that may warrant changes to the reclamation, including closure activities, described in the approved Plan of Operations. Where the operator proposes or the BLM requires modification to the proposed reclamation activities, including closure, the Plan of Operations must be modified.

The authorized officer is responsible for ensuring modifications to approved Plans of Operations, including mine closure decisions, are properly reviewed prior to approval. In assessing the need for additional NEPA documentation, the authorized officer should consider the significance of the proposed modification and the adequacy of the original NEPA documentation. Any Federal decision to approve a modification to an approved Plan of Operations must be in compliance with

the requirements of NEPA. If the modification involves actions that have been evaluated under previous NEPA review, the authorized officer may issue a Documentation of Land Use Plan Conformance and NEPA Adequacy (DNA).

The following actions will usually be considered a significant modification of an approved Plan of Operations. These actions will be analyzed in an appropriate NEPA document.

- The proposed modification involves disturbance or use of public land not covered in an approved Plan of Operations.

- The proposed modification is not fully covered in an existing NEPA document.

- The proposed modification has potential impacts not identified and analyzed during approval of the original Plan of Operations or subsequent modifications.

Any required NEPA document needs to consider the potential environmental impacts of the proposed modification, including impacts to resources associated with the unsaturated zone. For the purpose of this guidance document, the unsaturated zone is the portion of the earth immediately below the land surface and above the water table. Within this zone the pores contain both water and air, but are not totally saturated with water. If a mine closure plan proposes discharge of fluids then zero-discharge and fluid treatment alternatives must be considered in the NEPA document. Environmental analyses will be conducted according to BLM's NEPA guidelines contained in H-1790-1.

## COORDINATION

Early, consistent cooperation and participation by all Federal, State, local and Tribal entities with review and approval responsibilities for hardrock mining, including closure decisions, is likely the single most effective way to reduce costs and delays in the current approval process. For hardrock mining on public lands, the BLM is the lead agency and land manager, and as such needs to take the responsibility to ensure the appropriate coordination takes place with all parties. In addition to the need to coordinate with other governmental entities, the BLM needs to ensure it meets its obligations under NEPA to provide the public an opportunity to review and comment on decisions affecting public lands.

The Nevada BLM is specifically committed to coordinate and collaborate to the fullest extent practical with the State regulatory agencies responsible for the permitting and oversight of mine reclamation and closure activities. To aid in the coordination with the State regulatory agencies, BLM personnel need to understand the State permit requirements and approval process. When there is disagreement that cannot be resolved by the BLM field office and the BMRR, the issue

should be forwarded to the State Director through the Deputy State Director, Mineral Resources at the Nevada State Office for resolution.

**Bureau of Mining Regulation and Reclamation**

In Nevada, the State regulatory agency with primary responsibility for closure decisions is BMRR. For mine closure, BMRR requires the operator to submit several major documents for review and approval. Discussed below are the four BMRR documents required for mine closure: Tentative Permanent Closure Plan, Final Permanent Closure Plan, and Final Closure Report and Request for Final Closure. The description of these documents is intended to aid the BLM's understanding BMRR's closure process and to facilitate BLM in its commitment to coordinate with the State agencies on mine reclamation and closure issues.

**Tentative Permanent Closure Plan** - Reclamation, including closure, of a mine site is addressed in the Plan of Operations approved by the BLM. At the same time the Tentative Permanent Closure Plan is submitted to the BMRR as part of the Water Pollution Control Permit approval process. BLM and BMRR coordination on the Tentative Permanent Closure Plan should occur as part of the review and approval of the original Plan of Operations and Water Pollution Control Permit. However as these plans are submitted as part of the original mine approval, it may not reflect the reclamation options when a mine nears actual closure. Closure activities being proposed by the operator may represent a modification from what was originally approved. If the proposed closure method is not in the approved Plan of Operations, then the Plan of Operations must be modified.

**Final Permanent Closure Plan** - The operator is required to submit a Final Permanent Closure Plan to the BMRR two years prior to the anticipated closure of the mine site. (However, it should be noted that Final Permanent Closure Plans are not always submitted two years prior to closure as required.) In order to expedite the NEPA and State permitting processes, the operator should concurrently submit the Final Permanent Closure Plans to BMRR and any proposed modifications to the Plan of Operations to the BLM. Ideally, the process should flow as follows:

- Operator submits a Final Permanent Closure Plan to BMRR and appropriate modifications to the Plan of Operations to BLM.

- BLM, in coordination with BMRR, compares the Final Permanent Closure. Plan/Modification to the Plan of Operations with the approved Plan of Operations to determine whether the modifications are significant, and whether the modifications have been reviewed under previous NEPA analysis.

- If BLM determines new NEPA documentation is necessary, the BLM will coordinate with BMRR and the operator on project-specific issues, including schedules for review and approval of the plans.

- BLM assessment of potential impacts, including resources associated with the unsaturated zone, should occur at the same time as BMRR is reviewing water quality impacts.

- BLM prepares the appropriate NEPA documentation.

- If required, BLM and BMRR should coordinate public review of the NEPA document and modification to the Water Pollution Control Permit.

To meet BMRR's requirement, the Final Permanent Closure Plan provides closure goals and a detailed methodology of activities necessary to achieve a level of stabilization of all known and potential contaminants at the site. The Final Permanent Closure Plan also includes a detailed description of all proposed monitoring that will be conducted to demonstrate how the closure goals are being met. The operator must receive BMRR approval for the Final Permanent Closure Plan before initiating action. Activities including reshaping and regrading, covering, placing growth medium, applying soil amendments, and revegetation are in many cases major components of the site stabilization and closure process, and will be described or referenced as part of the Final Permanent Closure Plan.

It is in the operator's interest to review and amend the reclamation plan and bond cost calculations as general closure plans become more specific. Failure to properly document closure and reclamation activities may result in additional operator expenditures or project delays.

**Final Closure Report/Post-Closure Monitoring** - Following the completion of all closure related activities, a Final Closure Report is submitted to the BMRR that summarizes all completed closure related activities. This document should also be concurrently submitted to the BLM. Upon approval of the Final Closure Report, the mine site is considered to be in the "post-closure" period. The Request for Final Closure is made following the completion of the post-closure monitoring period. For BMRR purposes, this period lasts anywhere from five to a maximum of 30 years. The post-closure monitoring period is intended to validate the operators contention that those closure activities completed have indeed stabilized and verify no undue degradation of waters of the State. The request contains all pertinent post-closure monitoring information and clearly demonstrates stabilization. BLM 's post-reclamation responsibilities are defined on a case-by-case basis in the approved plan of operations. As such, the time frames used by BMRR may not be relevant or appropriate to the BLM requirements.

## Coordinated Review of Technical Issues

The BLM will cooperatively review and approve methodology and technology necessary to ensure adequate evaluation of water quality issues with BMRR. The agencies should concur on data adequacy and conclusions at the earliest possible time. Where appropriate, the BLM will utilize the State environmental regulatory requirements, guidance, standards and testing methods as the basis for its analyses and reviews. This includes deferring to the State BMRR and U.S. Environmental Protection Agency (EPA) decisions pursuant to their authority under the Clean Water Act, Safe Drinking Water Act, Resource Conservation and Recovery Act, and other applicable Federal and State environmental laws where appropriate. For your reference, attached is an EPA information sheet identifying federal requirements affecting groundwater discharge. Except for point source discharges to waters of the U.S., currently there are no numeric Federal standards for permitting discharges into the environment as part of mine closure. The overriding BLM standard is found in the 43 CFR 3809 regulations, specifically the requirement to prevent unnecessary or undue degradation.

## TECHNICAL ISSUES

This section of the guidance covers three technical issues: disposal of heap detoxification waters, disposal of heap drain-down waters, and disposal of process pond sludge. Each issue discussion contains methods and technical alternatives that should be evaluated under best management practices for water and sludge disposal.

**General Disposal Criteria** - The general criteria for review and decisions regarding disposal are:

- Compliance with all applicable Federal and State Laws
- Reduction and minimization of environmental harmful constituents
- Utilization of a risk management approach if necessary to address any remaining constituents or concerns.

**Disposal of Heap Detoxification and Heap Drain-Down Waters** - The following methods for the disposal of heap detoxification and heap drain-down waters should be evaluated in the Plan of Operations and NEPA document:

- Land application by infiltration, leach field, or injection of treated water
- Land application by infiltration, leach field, or injection of untreated water
- Evaporation (zero discharge)

The following information needs to be collected and evaluated for any proposed method of disposal:

- The locations for the proposed disposal
- Volume of disposal solutions
- Predicted drain-down analysis

In addition, the following information needs to be collected and evaluated for proposed land application methods of disposal:

- Chemical characteristics of the solution to be disposed
- Survey of surface waters (locations of streams, springs, lakes, wetlands)
- Depth of the shallowest water table or ground water aquifer
- Hydrogeological characteristics of the disposal area
- Ground water quality
- Soils and subsurface lithology, including attenuation analysis
- Vegetative survey
- Ecological survey

These analyses would include, but not be limited to, state-required analyses for potential degradation of waters of the State.

When disposing of detoxification and heap drain-down waters utilizing land disposal of any type, the soils and sediments in the subsurface need to be tested for metal content. The test methods for metal content in earth materials should conform to those identified in EPA/SW-846 or ASTM.

**Disposal of Process Pond Sludge** - Process pond sludge must be tested to determine metal content, pH, and water content prior to evaluating disposal alternatives. The test method utilized to test the sludge should be identified in either EPA/SW-846 or ASTM. In addition, the sludge should be dried to the greatest extent possible before disposal takes place, this can be completed by evaporating the water out of the sludge.

Ways to dispose of sludge:

- Dry the sludge and bury it on-site.
- Treat the sludge and bury it on-site.
- Remove the sludge to an off site facility.

If sludge(s) are disposed of on-site through burial, an appropriate cover and capping system must be designed to:

- Provide optimum evaporation.
- Provide optimum surface water run-off and routing.
- Provide in-place physical stabilization.
- Provide optimum evaporation (use of soil materials, vegetation, engineering design, etc.).
- Minimize infiltration through sludge burial system with geosynthetic liners.

**Risk Management** - A risk management approach may be initiated when all reasonable technologies have been used to reduce environmentally harmful constituents that may reside in soils, drain-down waters, effluents, and sludge.

When contaminants of concern are identified in either residual waters, soils or sludges during reclamation, and that material is being proposed for land application, a risk-based management process can be utilized if appropriate. The risk management process that must be used is outlined in the Environmental Protection Agency Guidance for Risk Assessment, as well as, other guidance referenced in this policy, such as BLM Management Criteria for Metals at BLM Mining Sites, Technical Note 390, 1996, revised 1999.

*The following steps outline the EPA guidance and should be accomplished:*

- Identify the type of contaminant(s) present and the threat posed to both human and ecological resources.
- Assess, through screening the waters, soils, and sludges to determine if site-specific contaminant levels are exceeding State, Federal and other appropriate standards.

- If contaminants exceed State, Federal, or other appropriate standards then conduct a risk assessment to determine the associated risk to human and ecological resources.

- The risk assessment will determine land application suitability and any additional treatment, redesign, mitigation necessary to ensure human and ecological health and safety.

- The risk assessment process will allow the BLM to make an informed decision on land application proposals with regard to reclamation plans.

BLM managers should adhere to the principles listed below when making human and ecological risk management decisions:

- The goal is to reduce human and ecological risks to levels that will result in the health and maintenance of the land for multiple use objectives.

- Use site specific human and ecological risk data to make informed decisions.

- Characterize the site risks.

- Communicate the risks to the public.

- Remediate and mitigate unacceptable human and ecological risk.

**Monitoring Water Disposal in the Unsaturated and Saturated Zones** - When land application is utilized to discharge and dispose of process and drain-down waters through an engineered system, the performance of the system must be monitored. The monitoring can be conducted by a monitoring point or series of monitoring points, specifically wells, piezometers and lysimeters.

The piezometers and lysimeters should be located within the soil or unsaturated lithology zone to collect any discharge and monitor the discharge process for unsaturated zone characteristics. The piezometers and lysimeters should be placed at varying depths and distances around and away from the engineered system.

The well(s) should be located in the saturated zone (water table or aquifer), down-gradient of the engineered system, and have enough coverage to account for both horizontal and vertical spatial movement of contaminants. The well(s) should also be located to show system or natural

conditions down-gradient from the discharge point(s) in distance increments. To observe the performance of the engineered system and confirm efficiency or effectiveness, wells should be placed at incremental distances down-gradient from the discharge point(s).

## FINANCIAL GUARANTEES

Adequate financial guarantees have long been recognized as an essential component of the BLM's effort to ensure the protection of the public lands. Specifically, financial guarantees are needed when an operator is unable or unwilling to perform reclamation, including closure activities, and other obligations. Existing guidance, *Nevada BLM Bonding Process for Plans of Operations Authorized by 43 CFR 3802/3809,* details the procedures for calculating, establishing and releasing financial guarantees.

For the BLM, closure does not occur until all obligations have been met. As such, the BLM must require some form of a financial guarantee to cover any long-term obligation, including maintenance of long-term water treatment systems and monitoring, that is identified in the approved Plan of Operations. Final release of the financial guarantee may not occur until all reclamation, including closure requirements, are met. These requirements include the need to maintain a financial guarantee until the operator can demonstrate the ability to discharge any residual effluents into the environment to meet standards approved in the Plan of Operations. BLM has the option of considering a separate financial instrument other than the reclamation bond, specific to long-term closure, water and effluent management or monitoring requirements if agreed to with the operator. The Plan of Operations and associated bond must cover maintenance and monitoring of all fluid disposal systems.

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## EPA Information Sheet

The purpose of this information sheet is to summarize Federal requirements affecting groundwater discharges in Nevada. The information sheet is arranged as a series of questions and answers.

**1. What Defines an Underground Source of Drinking Water?**

The Safe Drinking Water Act defines an Underground Source of Drinking Water (USDW) as and ground water containing 10,000 parts per million (ppm) or less total dissolved solid (TDS). However, EPA or a state can determine that water with less than 10,000 ppm TDS is exempted as an underground source of drinking water because of the factors such as: 1) whether or not it is currently a source of drinking water, 2) the economic and technical feasibility of extracting the water, 3) water quality of the aquifer (is it contaminated already, TDS too high to treat most effectively, or minerals or hydrocarbons naturally occur), or 4) subsidence or collapse likely is likely.

**2. Is there Federal authority to protect an Underground Source of Drinking Water?**

The Federal Safe Drinking Water Act (SDWA) Section 1431 gives EPA the authority to protect underground sources of drinking water. SDWA Section 1431 states that EPA can stop any activity which may cause an imminent and substantial endangerment to an underground source of drinking water.

**3. Does the Underground Injection Control Program Apply to the Groundwater Infiltration Basin or Leach Field?**

The Underground Injection Control (UIC) program was established under the Safe Drinking Water Act to protect ground water supplies. UIC program regulates the subsurface injection of waste fluids below, into and above underground sources of drinking water. Injection includes seeping, flowing, leaching and pumping with or without pressure. An injection well is a bored, drilled or driven shaft whose depth is greater than the largest surface dimension; or, a dug hole whose depth is greater than the largest surface dimension; or, an improved sinkhole; or subsurface fluid distribution system (an assemblage of perforated pipes, drain tiles, or other similar mechanisms intended to distribute fluids below the surface of the ground). These are the new rules, effective April, 2000. Nevada regulations currently do not include the subsurface fluid distribution system part, although leach fields, per NDEA policy, are considered injection wells.

The federal regulations are located at 40 CFR Part 144-147. There are five well classes:

Class I: Deep wells injecting below the lowermost USDW. Permit required.
Class II: Wells used for oil and gas production. Permit required.
Class III: Wells which inject fluids used mineral extraction. Permit required.
Class IV: Wells which inject hazardous or radioactive waste into or above a USDW. Prohibited except as a part of a CERCLA or RCRA clean-up action.
Class V: Shallow wells that discharge into or above a USDW. These wells are currently authorized by real, however all wells must 1) be inventoried and 2) cannot endanger a USDW. examples of Class V wells: dry wells collecting surface water runoff, automotive disposal wells, and septic tanks which accept industrial waste. A new Class V Rule was promulgated in December 1999, but only affects cesspools and automotive waste disposal wells. This rule added the new definition, and ties these well types to SWAP areas and sensitive ground water protection areas.

Percolation ponds are not covered by the federal UTC program because they do not fit the definition of injection well. Leach fields for drainage from a closed heap leach facility are currently not regulated under any of the five classes in the UIC program. However a facility would be covered under SDWA 1421 if it is endangering an underground source of drinking water.

**What will EPA look for in NEPA reviews for Closing Gold Heap Leach Facilities?**

Post-closure toxins mobility and acid generation may remain a problem for years the heap and subsequently in the heap drainage going out to an underground leach field. Some of the questions to ask when evaluating the chemical constituents of the water that will be discharged are:

- Look at the sulfide content of ore and spent ore. How was the geochemistry done? Were static or kinetic tests conducted?
- What are the performance standards for closure? What would be the requirements if the heap leach pile drainage were placed in percolation ponds if it is toxic?
- What is the geochemistry, structure, and hyrogeology of the substrate/rock under the heap leach pile drainage leach field?
- What is the fate and transport capability of each contaminant in the drainage water?
- What is the chemical composition of the solution remaining in the heap leach pile after the rinsing process to get below 0.2 mg/l CN in the residual solution? Will metals and other harmful contaminants become more concentrated in heaps over time?

- Over what period of time will salts in the heap leach pile be discharged to the leach field? How does the chemical composition of heap leach pile drainage vary over time? Do salts and metals accumulate in perc ponds and move down through substrate in increasing amounts?

- Look at heap cover design, vegetation, and climatic factors. Does it preclude meteoric water from moving down through closed heap?

- Look at the success criteria for reclamation/revegetation. How will integrity of cover be maintained?

- Should lime or other neautralizing agent be added to heap cover to neutralize meteoric water?

- What is the monitoring program for closure and post-closure leach field discharges to enable close tracking of water chemistry of changes and to evaluate the need for interventions?

- Closure monitoring should continue through at least one rest period (or dry season) and wet season after the water meets all standards to check for upward trends or spikes in contaminant concentrations.

- Are the leach fields going to receive heap leach pile drainage forever, or is there some period after which the leach fields will not longer be necessary?

- Have runon/runoff controls for closed heap piles been evaluated to reduce the infiltration of water into heap and erosion of cover?

- Are there contingency plans for large storm events, catastrophic failures of heaps infilitration rates too slow, etc.?

- Will post-closure passive or active maintenance be needed?

- Are there bonds for closure, reclamation, and post-closure activities for the heap leach piles and the heap leach pile drainage leach field?

- Does closure meet post-mining land uses?

- Where are drinking water wells, agricultural wells, and surface water bodies in the project vicinity? How could seepage from the project affect these wells and water bodies?

- Will seasonal changes affect the heap each drainage capacity or effectiveness?

- How are the closed facilities treated by regulatory agencies? Are they industrial facilities?

# APPENDIX B

# WATER RESOURCES AND GEOCHEMISTRY SUPPLEMENTAL DATA

## Table B-1
## Marigold Mine Waste Rock Amounts and Percentages

| Report Year | Sample Date | Location | Geologic Unit | Foundation Tons | Geologic Unit % Annual Basis | Tests Conducted | Comments |
|---|---|---|---|---|---|---|---|
| 1988 | | | | | | | |
| | | 8 South Waste | Alluvium | 3,625,360 | 100 | NA | Mining initiated Sept. 1988 |
| | | | 1988 Total Waste | 3,625,360 | | | |
| 1989 | | | | | | | |
| | | 8 South Waste | Alluvium | 10,866,384 | 76 | NA | |
| | | | Havallah Form. | 1,944,793 | 14 | NA | |
| | | | Antler/Battle Seq. | 1,137,308 | 8 | NA | |
| | | | Valmy Form. | 274,138 | 2 | NA | |
| | | | 1989 Total Waste | 14,222,623 | | | |
| 1990 | | | | | | | |
| | | 8 South Waste | Alluvium | 7,568,496 | 65 | NA | |
| | | 8 South Waste | Havallah | 1,298,161 | 11 | NA | |
| | | 8 South Waste | Antler/Battle Seq. | 1,998,134 | 17 | NA | |
| | | 8 South Waste | Valmy Form. | 456,523 | 4 | NA | |
| | | Top Zone | Valmy Form. | 343,033 | 3 | NA | |
| | | | 1990 Total Waste | 11,664,347 | | | |
| 1991 | | | | | | | |
| | 01/07/92 | 8 South Waste | Alluvium | 6,239,752 | 57 | MWMP, AGP | 1st characterization required |
| | | 8 South Waste | Havallah | 1,182,719 | 11 | | |
| | | 8 South Waste | Antler/Battle Seq. | 1,764,941 | 16 | | |
| | | 8 South Waste | Valmy Form. | 1,185,171 | 11 | | |
| | | Top Zone Waste | Valmy Form. | 560,329 | 5 | MWMP, AGP | |
| | | | 1991 Total Waste | 10,932,912 | | | |
| 1992 | | | | | | | |
| 1st Q | 03/27/92 | 8 South Waste | Alluvium | 627,140 | 18.9 | MWMP, AGP | MWMP @ 6/15, AGP @ 7/21 |
| | | 8 South Waste | Havallah | 171,616 | 5.2 | | |
| | | 8 South Waste | Antler/Battle Seq. | 39,803 | 1.2 | | |
| | | 8 South Waste | Valmy Form. | 159,886 | 4.8 | | |
| | | Top Zone Waste | Valmy Form. | 562,360 | 17.0 | MWMP, AGP | MWMP @ 6/15, AGP @ 7/21 |
| | | | | | | | |
| 2nd Q | 06/15/92 | 8 South Waste | Alluvium | 16,979 | 0.5 | MWMP Only | |
| | | 8 South Waste | Havallah | 22,727 | 0.7 | | |
| | | 8 South Waste | Antler/Battle Seq. | 223,665 | 6.8 | | |
| | | 8 South Waste | Valmy Form. | 137,701 | 4.2 | | |
| | | Top Zone Waste | Valmy Form. | 455,753 | 13.8 | MWMP Only | |
| | | | | | | | |

Source: Marigold Mine

## Table B-1
## Marigold Mine Waste Rock Amounts and Percentages

| Report Year | Sample Date | Location | Geologic Unit | Foundation Tons | Geologic Unit % Annual Basis | Tests Conducted | Comments |
|---|---|---|---|---|---|---|---|
| 3rd Q | 11/23/92 | 8 South Waste | Havallah | 10,816 | 0.3 | AGP Only | |
| | | 8 South Waste | Antler/Battle Seq. | 101,588 | 3.1 | | |
| | | 8 South Waste | Valmy Form. | 153,741 | 4.6 | | |
| | | East Hill | Valmy Form. | 5,816 | 0.2 | | |
| | | Top Zone Waste | Valmy Form. | 198,562 | 6.0 | AGP Only | |
| | | | | | | | |
| 3rd Q | 12/02/92 | 8 South Waste | | | | AGP Only | |
| | | Top Zone Waste | Valmy Form. | | | AGP Only | |
| | | | | | | | |
| 4th Q | 02/03/93 | 8 South Waste | Havallah | 13,768 | 0.4 | MWMP Only | MWMP @ 2/3 |
| | | 8 South Waste | Antler/Battle Seq. | 108,185 | 3.3 | | |
| | | 8 South Waste | Valmy Form. | 137,923 | 4.2 | | |
| | | Top Zone Waste | Valmy Form. | 161,810 | 4.9 | MWMP Only | MWMP @ 2/3 |
| | | | | | | | |
| 4th Q | 02/11/93 | 8 South Waste | | | | AGP Only | |
| | | Top Zone Waste | | | | AGP Only | |
| | | | | | | | |
| | All Q's | | 1992 Total Waste | 3,309,839 | | | |
| 1993 | | | | | | | |
| | All Q's | 8 South Waste | Composited Q | 809,595 | 16 | MWMP, AGP | |
| | All Q's | Top Zone Waste | Composited Q | 1,406,591 | 28 | MWMP, AGP | |
| | 3rd & 4th Q's | East Hill Waste | Composited Q | 2,791,539 | 56 | MWMP, AGP | |
| | All Q's | | 1993 Total Waste | 5,007,725 | | | |
| 1994 | | | | | | | |
| | Annual Composites | 8 South Waste | Valmy | 151,877 | 2 | MWMP, AGP | New format |
| | | | Antler/Battle | 404,631 | 5 | MWMP, AGP | |
| | | Top Zone Waste | Valmy | 1,373,033 | 19 | MWMP, AGP | |
| | | East Hill Waste | Havallah | 398,072 | 5 | MWMP, AGP | |
| | | | Valmy | 3,317,270 | 45 | MWMP, AGP | |
| | | | Antler/Battle | 707,685 | 10 | MWMP, AGP | |
| | | Red Rock | Antler/Battle | 1,044,851 | 14 | MWMP, AGP | |
| | All Q's | | 1994 Total Waste | 7,397,419 | | | |
| | | | | | | | |

Source: Marigold Mine

## Table B-1
## Marigold Mine Waste Rock Amounts and Percentages

| Report Year | Sample Date | Location | Geologic Unit | Foundation Tons | Geologic Unit % Annual Basis | Tests Conducted | Comments |
|---|---|---|---|---|---|---|---|
| 1995 | | | | | | | |
| | Annual Composites | East Hill | Havallah | 543,557 | 13 | MWMP, AGP | |
| | | | Antler/Battle | 1,358,894 | 33 | MWMP, AGP | |
| | | | Valmy | 373,147 | 9 | MWMP, AGP | |
| | | Red Rock | Antler/Battle | 475,237 | 12 | MWMP, AGP | |
| | | | Valmy | 155,545 | 4 | MWMP, AGP | |
| | | Top Zone | Valmy | 1,169,849 | 29 | MWMP, AGP | |
| | All Q's | | 1995 Total Waste | 4,076,229 | | | |
| 1996 | | | | | | | |
| | Annual Composites | East Hill | Antler/Battle | 661,811 | 7 | MWMP, AGP | |
| | | | Valmy | 3,750,265 | 42 | MWMP, AGP | |
| | | Top Zone | Antler/Battle Seq. | 365,450 | 4 | MWMP, AGP | |
| | | | Valmy Form. | 4,201,678 | 47 | MWMP, AGP | |
| | All Q's | | 1996 Total Waste | 8,979,204 | | | |
| 1997 | | | | | | | |
| | Annual Composites | Top Zone | Valmy | 5,701,801 | 66 | MWMP, AGP | |
| | | | Antler/Battle | 1,241,504 | 14 | MWMP, AGP | |
| | | East Hill North | Valmy | 889,061 | 10 | MWMP, AGP | |
| | | East Hill South | Valmy | 765,975 | 9 | MWMP, AGP | |
| | All Q's | | 1997 Total Waste | 8,598,341 | | | |
| 1998 | | | | | | | |
| | Annual Composites | Old Marigold | | | | | |
| | | East Hill North | | | | | |
| | | East Hill South | | | | | |
| | | Top Zone North | | | | | |
| | | Top Zone South | | | | | |
| | All Q's | | 1998 Total Waste | | | | |
| | | | | | | | |

Source: Marigold Mine

**Table B-2**
**Marigold Mine**
**Static Acid-Base Accounting Analyses**

| TAILINGS SOLIDS | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SULFUR CONTENT | | | | AGP (T/kT CaCO3) | | ANP (T/kT CaCO3) | NNP (T/kT CaCO3) | | ANP/AGP | | PASTE pH |
| SAMPLE | PYRITIC SULFUR (%) | SULFATE SULFUR (%) | UNIDENT SULFUR (%) | TOTAL SULFUR (%) | PYRITIC SULFUR | TOTAL SULFUR | | PYRITIC SULFUR | TOTAL SULFUR | PYRITIC SULFUR | TOTAL SULFUR | |
| **Tailing Solids** (F346-02A) 1/14/92 | 0.01 | 0.03 | -0.01 | 0.04 | 0.3 | 1.2 | 334 | 333.7 | 332.8 | 1113.33 | 278.33 | |
| **Tailing Solids** (G071-02B) 4/28/92 | 0.04 | -0.01 | -0.01 | 0.04 | 1.2 | 1.2 | 61.3 | 60.1 | 60.1 | 51.08 | 51.08 | |
| **Tailings Solids** (G303-04A) 12/2/92 | 0.01 | 0.02 | -0.01 | 0.03 | 0.3 | 0.9 | 49 | 48.7 | 48.1 | 163.33 | 54.44 | |
| **Tailings Solids** (Monitor Lab 1493) | | | | | | 30.9 | 196 | | 165.1 | | 5.34 | 9.02 |
| **Tailing Solids** (H006-04A) 2/11/93 | 0.01 | 0.04 | 0.96 | 1.01 | 0.3 | 3.03 | 20.4 | 20.1 | 17.37 | 68.00 | 6.73 | |
| **Tailings Solids (1st)** (SVL E42468A) 7/12/93 | | | | | | 15 | 19.7 | | 4.7 | | 0.31 | 9.52 |
| **Tailings Solids (2nd)** (SVL E42469) 7/12/93 | | | | | | 9.4 | 23.4 | | 14 | | 1.49 | 9.65 |
| **Tailings Solids (3rd)** (SVL E52347) 12/2/93 | 0.89 | 0.02 | 0.69 | 1.6 | 26.7 | 48 | 119 | 92.3 | 71 | 4.46 | 2.48 | 8.58 |
| **Tailings Solids (4th)** (SVL E52348) 12/2/93 | 0.64 | 0.05 | 0.85 | 1.54 | 19.2 | 46.2 | 118 | 98.8 | 71.8 | 6.15 | 2.55 | 8.63 |
| **Tails Comp-1** (SVL E76071) 2/5/94 | | | | | | 25 | 173 | | 148 | | 5.92 | 8.64 |
| **Tails Comp-2** (SVL E76072) 12/5/94 | | | | | | 25.2 | 172 | | 146.8 | | 5.83 | 8.86 |
| | | | | | | | | | | | | |
| LEACH SOLIDS | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| **Top Zone Leach** (G071-02B)4/28/92 | 0.14 | -0.01 | -0.01 | 0.14 | 4.4 | 4.4 | 29.7 | 25.3 | 25.3 | 6.75 | 6.75 | |
| **8 South Leach** (G071-02B) 4/28/92 | 0.15 | -0.01 | 1.36 | 1.51 | 4.7 | 47.2 | 25.4 | 20.7 | -21.8 | 5.40 | 0.54 | |
| **8-South Leach** (G303-04A) 12/2/92 | 0.01 | 0.05 | 1.9 | 1.96 | 0.3 | 61.2 | 15.3 | 15 | -45.9 | 51.00 | 0.25 | |
| **Top Zone Leach** (G303-04A) 12/2/92 | 0.01 | 0.05 | -0.01 | 0.06 | 0.3 | 1.8 | 7.4 | 7.1 | 5.6 | 24.67 | 4.11 | |
| **Top Zone Leach** (Monitor Lab 1493) 6/17/92 | | | | | | 3.34 | 10.2 | | 6.86 | | 2.05 | 8.33 |
| **8-South Leach** (Monitor Lab 1493) 6/17/92 | | | | | | 21.3 | 127 | | 105.7 | | 4.96 | 8.27 |
| **8-South Leach** (H006-04A) 2/11/93 | 0.03 | 0.08 | -0.01 | 0.11 | 0.9 | 3.3 | 32.8 | 31.9 | 29.5 | 36.44 | 9.94 | |
| **Top Zone Leach** (H006-04A) 2/11/93 | 0.03 | 0.04 | -0.01 | 0.07 | 0.9 | 2.1 | 45 | 44.1 | 42.9 | 50.00 | 21.43 | |
| **8-South Leach (1st)** (SVL E42464) 7/12/93 | | | | | | 0.6 | 20.1 | | 19.5 | | 32.50 | 8.15 |
| **8-South Leach (2nd)** (SVL E42466) 7/12/93 | | | | | | 19.2 | 30 | | 10.8 | | 0.56 | 7.74 |
| **8-South Leach (3rd)** (SVL E52340) 12/2/93 | 0.17 | -0.01 | 2.04 | 2.21 | 5.1 | 66.3 | 148 | 142.9 | 81.7 | 29.02 | 2.23 | 8.17 |
| **8-South Leach (4th)** (SVL E52341) 12/2/93 | 0.48 | -0.01 | 1.25 | 1.73 | 14.4 | 51.9 | 204 | 189.6 | 152.1 | 14.17 | 3.93 | 8 |
| **Top Zone Leach (1st)** (SVL E42470) 7/12/93 | | | | | | 0.3 | 6 | | 5.7 | | 19.00 | 8.62 |
| **Top Zone Leach (2nd)** (SVL E42472) 7/12/93 | | | | | | 0.8 | 10.4 | | 9.6 | | 12.00 | 8.12 |
| **Top Zone Leach (4th)** (SVL E52346) 12/2/93 | 0.15 | 0.03 | 0.01 | 0.19 | 4.5 | 5.7 | 18.1 | 13.6 | 12.4 | 4.02 | 3.18 | 7.91 |
| **East Hill Leach (1st)** (SVL E52434) 12/2/93 | 0.75 | 0.24 | 0.59 | 1.58 | 22.5 | 47.4 | 101 | 78.5 | 53.6 | 4.49 | 2.13 | 8.12 |

Table B-2
Marigold Mine
Static Acid-Base Accounting Analyses

| 8 SOUTH WASTE | SULFUR CONTENT | | | | AGP (T/kT CaCO3) | | ANP (T/kT CaCO3) | NNP (T/kT CaCO3) | | ANP/AGP | | PASTE pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLE | PYRITIC SULFUR (%) | SULFATE SULFUR (%) | UNIDENT SULFUR (%) | TOTAL SULFUR (%) | PYRITIC SULFUR | TOTAL SULFUR | | PYRITIC SULFUR | TOTAL SULFUR | PYRITIC SULFUR | TOTAL SULFUR | |
| **8-South Waste** (F346-02A) 1/14/92 | 0.02 | 0.04 | -0.01 | 0.06 | 0.6 | 1.8 | 19.6 | 19 | 17.8 | 32.67 | 10.89 | |
| **8-South Waste** (G071-02B) 4/28/92 | 0.12 | -0.01 | -0.01 | 0.12 | 3.8 | 3.8 | 60.2 | 56.4 | 56.4 | 15.84 | 15.84 | |
| **8-South Waste** (G303-04A) 12/2/92 | 0.01 | 0.06 | -0.01 | 0.07 | 0.3 | 2.1 | 442 | 441.7 | 439.9 | 1473.33 | 210.48 | |
| **8-South Waste** (Monitor Lab 1493) 6/17/92 | | | | | | 2.19 | 129 | | 126.81 | | 57.90 | 8.32 |
| **8-South Waste** (H006-04A) 2/11/93 | 0.02 | 0.04 | -0.01 | 0.06 | 0.6 | 1.8 | 86 | 85.4 | 84.2 | 143.33 | 47.78 | |
| **8-South Waste (1st)** (SVL E42465) 7/12/93 | | | | | | 4.4 | 63.3 | | 58.9 | | 13.39 | 8.73 |
| **8-South Waste (2nd)** (SVL E42465) 8/3/93 | | | | | | 1.5 | 22.9 | | 21.4 | | 14.27 | 8.01 |
| **8-South Waste (3rd)** (SVL E52342) 12/2/93 | 0.66 | -0.01 | 0.07 | 0.73 | 19.8 | 21.9 | 38.8 | 19 | 16.9 | 1.96 | 1.77 | 7.89 |
| **8-South Waste (4th)** (SVL E52343) 12/2/93 | 0.74 | -0.01 | 0.56 | 1.3 | 22.2 | 39 | 121 | 98.8 | 82 | | 2.10 | 7.92 |
| **8-South Valmy** (SVL E76062) 12/5/94 | | | | | | 0.3 | 36.7 | | 36.4 | | 121.33 | 7.71 |
| **8-South Antler** (SVL E76063) 12/5/94 | | | | | | 0.3 | 548 | | 547.7 | | 1825.67 | 8.46 |
| **8-South Battle** (SVL E76064) 12/5/94 | | | | | | 2.1 | 36.4 | | 34.3 | | 16.33 | 8.57 |
| TOP ZONE NORTH WASTE | | | | | | | | | | | | |
| **Top Zone Waste** (F346-02A) 1/14/92 | -0.01 | 0.01 | -0.01 | 0.01 | -0.3 | 0.3 | 4.3 | 4.6 | 4 | -14.33 | 14.33 | |
| **Top Zone Waste** (G071-02B) 4/28/92 | 0.44 | -0.01 | -0.01 | 0.44 | 13.8 | 13.8 | 30.7 | 16.9 | 16.9 | 2.22 | 2.22 | |
| **Top Zone Waste** (G303-04A) 12/2/92 | 0.01 | 0.1 | -0.01 | 0.11 | 0.3 | 3.3 | 10.2 | 9.9 | 6.9 | 34.00 | 3.09 | |
| **Top Zone Waste** (Monitor Lab 1493) 6/17/92 | | | | | | 4.38 | 12 | | 7.62 | | 1.74 | 8.66 |
| **Top Zone Waste** (H006-04A) 2/11/93 | 0.03 | 0.02 | -0.01 | 0.05 | 0.9 | 1.5 | 41 | 40.1 | 39.5 | 45.56 | 27.33 | |
| **Top Zone Waste (1st)** (SVL E42471) 7/12/93 | | | | | | 1.4 | 15.9 | | 14.5 | | 10.36 | 9.35 |
| **Top Zone Waste (2nd)** (SVL E42473) 7/12/93 | | | | | | 0.3 | 10 | | 9.7 | | 32.33 | 8.52 |
| **Top Zone Waste (3rd)** (SVL E52344) 12/2/93 | 0.06 | 0.01 | -0.01 | 0.07 | 1.8 | 2.1 | 23.7 | 21.9 | 21.6 | 13.17 | 11.29 | 8.13 |
| **Top Zone Waste (4th)** (SVL E52345) 12/2/93 | 0.04 | 0.01 | -0.01 | 0.05 | 1.2 | 1.5 | 19.6 | 18.4 | 18.1 | 16.33 | 13.07 | 7.81 |
| **Top Zone Valmy** (SVL E76065) 12/5/94 | | | | | | 0.3 | 7.1 | | 6.8 | | 22.67 | 8.44 |
| **Top Zone Valmy (1995)** (SVL 144632) 6/4/97 | 0.01 | -0.01 | -0.01 | 0.01 | 0.3 | 0.3 | 4.9 | 4.6 | 4.6 | 16.33 | 16.33 | |
| **Top Zone Antler (1996)** (SVL 144633) | 0.03 | 0.01 | -0.01 | 0.04 | 0.3 | 1.2 | 404 | 403.7 | 402.8 | 1346.67 | 336.67 | |
| **Top Zone Valmy (1996)** (SVL 144634) | 0.05 | 0.04 | -0.01 | 0.09 | 1.6 | 2.8 | 12.2 | 10.6 | 9.4 | 7.63 | 4.36 | |
| **Top Zone Antler (1997)** (SVL 158910) | 0.01 | 0.05 | -0.01 | 0.06 | 0.3 | 1.8 | 372 | 371.7 | 370.2 | 1240.00 | 206.67 | |
| **Top Zone Valmy (1997)** (SVL 158911) | 0.01 | 0.02 | -0.01 | 0.03 | 0.3 | 0.9 | 372 | 371.7 | 371.1 | 1240.00 | 413.33 | |

**Table B-2**
**Marigold Mine**
**Static Acid-Base Accounting Analyses**

| TOP ZONE WASTE | SULFUR CONTENT | | | | AGP (T/kT CaCO3) | | ANP (T/kT CaCO3) | NNP (T/kT CaCO3) | | ANP/AGP | | PASTE pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLE | PYRITIC SULFUR (%) | SULFATE SULFUR (%) | UNIDENT SULFUR (%) | TOTAL SULFUR (%) | PYRITIC SULFUR | TOTAL SULFUR | | PYRITIC SULFUR | TOTAL SULFUR | PYRITIC SULFUR | TOTAL SULFUR | |
| Top Zone South Waste Antler (6/4/97) | 0.03 | 0.01 | -0.01 | 0.04 | 0.9 | 1.2 | 404 | 403.1 | 402.8 | 448.89 | 336.67 | |
| Top Zone South Waste Valmy (6/4/97) | 0.05 | 0.04 | -0.01 | 0.09 | 1.5 | 2.7 | 12.2 | 10.7 | 9.5 | 8.13 | 4.52 | |
| Top Zone South Waste Valmy (11/19/97) | 0.01 | 0.05 | -0.01 | 0.06 | 0.3 | 1.8 | 372 | 371.7 | 370.2 | 1240.00 | 206.67 | |
| Top Zone South Waste Antler (11/19/97) | 0.01 | 0.02 | -0.01 | 0.03 | 0.3 | 0.9 | 10.2 | 9.9 | 9.3 | 34.00 | 11.33 | |
| EAST HILL NORTH WASTE | | | | | | | | | | | | |
| East Hill Waste (3rd) (SVL E52349) 12/2/93 | -0.01 | 0.08 | -0.01 | 0.08 | 0.3 | 2.4 | 39.7 | 39.4 | 37.3 | 132.33 | 16.54 | 8.1 |
| East Hill Waste (4th) (SVL E52350) 12/2/93 | 0.06 | 0.03 | -0.01 | 0.09 | 1.8 | 2.7 | 45.4 | 43.6 | 42.7 | 25.22 | 16.81 | 8.14 |
| East Hill Havallah (SVL E76066) 12/5/94 | | | | | | 1 | 56 | | 55 | | 55.00 | 8.95 |
| East Hill Valmy (SVL E76067) 12/5/94 | | | | | | 0.3 | 4.9 | | 4.6 | | 15.33 | 8.36 |
| East Hill Antler (SVL E76068) 12/5/94 | | | | | | 0.3 | 690 | | 689.7 | | 2299.00 | 8.95 |
| East Hill Havallah (1995) (SVL 144627) 6/4/97 | 0.05 | 0.05 | -0.01 | 0.1 | 1.6 | 3.2 | 40.3 | 38.7 | 37.1 | 25.19 | 12.59 | |
| East Hill Antler (1995) (SVL 144628) 6/4/97 | 0.01 | 0.03 | -0.01 | 0.04 | 0.3 | 1.2 | 703 | 702.7 | 701.8 | 2343.33 | 585.83 | |
| East Hill Valmy (1995) (SVL 144629) 6/4/97 | 0.01 | -0.01 | -0.01 | 0.01 | 0.3 | 0.3 | 5.8 | 5.5 | 5.5 | 19.33 | 19.33 | |
| East Hill Antler (1996) (SVL 144630) 6/4/97 | 0.01 | 0.02 | -0.01 | 0.03 | 0.3 | 0.9 | 563 | 562.7 | 562.1 | 1876.67 | 625.56 | |
| East Hill Valmy (1996) (SVL 144631) 6/4/97 | -0.01 | -0.01 | -0.01 | 0.01 | 0.3 | 0.3 | 1.8 | 1.5 | 1.5 | 6.00 | 6.00 | |
| East Hill N Valmy (1997) (SVL 158908) 11/19/97 | -0.01 | -0.01 | -0.01 | 0.01 | 0.3 | 0.3 | 6 | 5.7 | 5.7 | 20.00 | 20.00 | |
| EAST HILL SOUTH WASTE | | | | | | | | | | | | |
| East Hill S Valmy (1997) (SVL 158909) 11/19/97 | 0.04 | 0.05 | -0.01 | 0.09 | 1.3 | 2.7 | 37.8 | 36.5 | 35.1 | 29.08 | 14.00 | |
| RED ROCK NORTH WASTE | | | | | | | | | | | | |
| Red Rock Battle (SVL E76069) 12/5/94 | | | | | | 0.3 | 488 | | 487.7 | | 1625.67 | 9.3 |
| Red Rock Antler (SVL E76070) 12/5/94 | | | | | | 0.3 | 150 | | 149.7 | | 499.00 | 9.07 |
| Red Rock Antler (1995) (SVL 144635) 6/4/97 | 0.06 | -0.01 | -0.01 | 0.06 | 1.9 | 1.9 | 526 | 524.1 | 524.1 | 276.84 | 276.84 | |
| Red Rock Valmy (1995) (SVL 144636) 6/4/97 | -0.01 | -0.01 | -0.01 | 0.01 | 0.3 | 0.3 | 8.9 | 8.6 | 8.6 | 29.67 | 29.67 | |

**Table B-2**
**Marigold Mine**
**Static Acid-Base Accounting Analyses**

| SAMPLE | SULFUR CONTENT | | | | AGP (T/kT CaCO3) | | ANP (T/kT CaCO3) | NNP (T/kT CaCO3) | | ANP/AGP | | PASTE pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PYRITIC SULFUR (%) | SULFATE SULFUR (%) | UNIDENT SULFUR (%) | TOTAL SULFUR (%) | PYRITIC SULFUR | TOTAL SULFUR | | PYRITIC SULFUR | TOTAL SULFUR | PYRITIC SULFUR | TOTAL SULFUR | |
| 5 NORTH WASTE | | | | | | | | | | | | |
| 5 North Antler Peak (1998) (SVL 192045) | 0.06 | 0.06 | 0 | 0.12 | 1.9 | 3.8 | 542 | 540.1 | 538.2 | 285.26 | 142.63 | 8.24 |
| 5 North Battle Fm (1998) (SVL 192046) | 0.01 | 0.02 | 0 | 0.03 | 0.3 | 0.9 | 214 | 213.7 | 213.1 | 713.33 | 237.78 | 8 |
| 5 North Edna Mtn (1998) (SVL 192047) | 0.13 | 0.04 | 0 | 0.17 | 4.1 | 5.3 | 96.5 | 92.4 | 91.2 | 23.54 | 18.21 | 7.86 |
| 5 North Havallah (1998) (SVL 192048) | 0.08 | 0.01 | 0 | 0.09 | 2.5 | 2.8 | 20.8 | 18.3 | 18 | 8.32 | 7.43 | 7.81 |
| 8 NORTH WASTE | | | | | | | | | | | | |
| 8 North Edna Mtn (1998) (SVL 192049) | 0.33 | 0 | 0.05 | 0.38 | 10.4 | 12 | 51.2 | 40.8 | 39.2 | 4.92 | 4.27 | 7.98 |
| 8 North Havallah (1998) (SVL 192050) | 0.13 | 0 | 0.08 | 0.21 | 4.1 | 6.6 | 14 | 9.9 | 7.4 | 3.41 | 2.12 | 7.89 |

*Note: pH is measured in standard units; all other constituents are measured in mg/l.*

## Table B-3
## Marigold Mine Meteoric Water Mobility Procedure Analyses

| TAILINGS SOLIDS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLE LOC. | Tailing | Tailing | Tailings | Tailings | Tailings | Tailings | Tailings | Tailings | Tailings | Tailings |
| SAMPLE TYPE | Solids | Solids | Solids | Solids | Solids (1st) | Solids (2nd) | Solids (3rd) | Solids (4th) | Comp-1 | Comp-2 |
| SAMPLE NO. | F246-02 | G071-02 | G303-04L | H006-04L | E42468A | E42469 | E52347 | E52348 | E76071 | E76072 |
| DATE | 1992 | 4/10/92 | 11/23/92 | 2/3/93 | 7/12/93 | 7/12/93 | 12/2/93 | 12/2/93 | 2/5/94 | 2/5/94 |
| CROSS REF | ABA-3 | ABA-8 | ABA-13 | ABA-23 | ABA-42 | ABA-43 | ABA-44 | ABA-45 | ABA-55 | ABA-56 |
| CONSTITUENT | | | | | | | | | | |
| pH | 8.96 | 8.79 | 8.3 | 8.2 | 8.8 | 8.9 | 8.6 | 8.6 | 8.4 | 8.5 |
| TDS | 428 | 390 | 412 | 374 | 227 | 273 | 115 | 233 | 178 | 191 |
| SULFATE | 12.5 | 20.6 | 104 | 41.6 | 53.8 | 69.4 | 29 | 66.9 | 38.3 | 43.1 |
| ALKALINITY | 44 | 44 | 103 | 126 | 61 | 77 | 67 | 88 | 66 | 63 |
| CHLORIDE | 33.15 | 20 | 53.18 | 43 | 21.8 | 22.2 | 9.1 | 21.2 | 13.2 | 14.2 |
| NITRATE | 1 | 0.24 | 1.23 | 1.16 | 2.32 | 2.22 | 0.25 | 1.09 | 0.5 | 0.45 |
| PHOSPHORUS | 0.919 | 0.395 | 0.35 | 0.716 | 0.08 | 0.11 | <0.07 | 0.08 | <0.3 | <0.3 |
| WAD CYANIDE | 0.4 | 0.122 | <0.02 | 0.87 | 0.28 | 0.12 | 0.1 | 0.23 | 0.167 | 0.201 |
| ALUMINUM | 1.062 | 1.484 | 0.172 | 9.42 | 0.87 | 0.2 | 0.06 | 0.05 | 0.07 | <0.03 |
| ANTIMONY | <0.025 | <0.05 | <0.05 | <0.05 | 0.014 | 0.2 | 0.014 | 0.026 | 0.012 | 0.017 |
| ARSENIC | 0.636 | 0.068 | 2.02 | 0.304 | 0.44 | 3.88 | 0.31 | 3.73 | 0.59 | 1.22 |
| BARIUM | 2.051 | 0.582 | 0.32 | 1.465 | 0.298 | 0.154 | 0.12 | 0.056 | 0.23 | 0.189 |
| CADMIUM | <0.005 | 0.14 | <0.005 | <0.005 | 0.002 | <0.002 | <0.002 | <0.002 | <0.004 | <0.004 |
| CHROMIUM | <0.025 | 0.078 | 0.336 | 0.019 | 0.011 | 0.09 | <0.004 | 0.257 | 0.011 | 0.019 |
| COBALT | <0.007 | 0.032 | <0.015 | 0.027 | 0.042 | 0.014 | 0.017 | 0.033 | <0.008 | <0.008 |
| COPPER | <0.5 | 0.116 | 0.22 | 0.03 | 0.01 | 0.008 | <0.005 | <0.005 | <0.003 | 0.003 |
| FLUORIDE | 0.143 | <0.2 | 5.65 | 0.34 | 0.3 | 4.1 | 0.3 | 2.6 | 0.62 | 0.64 |
| IRON | 1.347 | 1.47 | 0.68 | 6.55 | 1.36 | 0.28 | 0.54 | 0.47 | 0.349 | 0.343 |
| LEAD | <0.025 | <0.025 | <0.01 | <0.025 | 0.002 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| MANGANESE | 0.176 | 0.193 | 0.032 | 0.134 | <0.002 | <0.002 | 0.007 | <0.002 | <0.002 | <0.002 |
| MERCURY | <0.001 | 0.1775 | 0.171 | 0.0499 | 0.1 | 0.25 | 0.0003 | 0.305 | 0.113 | 0.214 |
| MOLYBDENUM | 0.045 | 0.024 | 0.029 | <0.01 | 0.039 | 0.04 | 0.02 | 0.046 | 0.01 | 0.02 |
| NICKEL | <0.015 | 0.125 | <0.025 | 0.043 | 0.04 | 0.02 | 0.02 | 0.02 | <0.02 | <0.02 |
| SELENIUM | <0.005 | <0.005 | <0.002 | <0.002 | <0.04 | <0.04 | 0.002 | 0.013 | <0.04 | <0.04 |
| SILVER | <0.025 | <0.02 | <0.05 | <0.05 | 0.005 | 0.007 | <0.003 | 0.006 | <0.004 | <0.004 |
| THALLIUM | 0.037 | 0.225 | <0.1 | <0.1 | <0.001 | 0.001 | 0.001 | 0.004 | <0.001 | <0.001 |
| TIN | 0.007 | 0.022 | <0.05 | <0.05 | <0.06 | <0.06 | <0.03 | <0.03 | <0.04 | <0.04 |
| VADADIUM | 0.047 | 0.101 | <0.01 | 0.034 | 0.034 | 0.081 | 0.011 | 0.029 | <0.01 | <0.01 |
| ZINC | 0.088 | 0.13 | <0.05 | <0.05 | 0.008 | 0.004 | <0.002 | <0.002 | <0.004 | <0.004 |

## Table B-3
## Marigold Mine Meteoric Water Mobility Procedure Analyses

| TAILINGS SOLIDS | Tailings Solids | Tailings Solids | Tailings Solids | Tailings Solids | Tailings Solids | Tailings Solids | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLE LOC. | Monitor Lab | | | | | | | | | |
| SAMPLE TYPE | 1992 | 2/7/96 | 2/5/94 | 2/5/94 | 4/7/98 | 1/10/97 | | | | |
| SAMPLE NO. | ABA-18 | | | | | | | | | |
| DATE | | | | | | | | | | |
| CROSS REF | | | | | | | | | | |
| | | | | | | | | | | |
| CONSTITUENT | | | | | | | | | | |
| | | | | | | | | | | |
| pH | 8.6 | 8.76 | 8.4 | 8.5 | 8.72 | 9.1 | | | | |
| TDS | 279 | 145 | 178 | 191 | 315 | 251 | | | | |
| SULFATE | 53.9 | 28.4 | 38.3 | 43.1 | 62.8 | 51.1 | | | | |
| ALKALINITY | 39.9 | 57.8 | 66 | 63 | 78.2 | 74.3 | | | | |
| CHLORIDE | 43.6 | 4.88 | 13.2 | 14.2 | | 40.4 | | | | |
| NITRATE | 2.6 | 2.14 | 0.5 | 0.45 | 2.55 | 8.33 | | | | |
| PHOSPHORUS | 0.046 | <0.18 | <0.03 | <0.3 | <0.11 | <0.11 | | | | |
| WAD CYANIDE | | 0.04 | 0.167 | 0.201 | 0.36 | 0.24 | | | | |
| | | | | | | | | | | |
| ALUMINUM | | 0.03 | 0.07 | <0.03 | <0.037 | 0.711 | | | | |
| ANTIMONY | | 0.043 | 0.012 | 0.017 | 0.055 | 0.013 | | | | |
| ARSENIC | 5.02 | 0.36 | 0.59 | 1.22 | 1.62 | 0.62 | | | | |
| BARIUM | | 0.236 | 0.23 | 0.189 | 0.188 | 0.189 | | | | |
| CADMIUM | | <0.0024 | <0.004 | <0.004 | <0.002 | <0.002 | | | | |
| CHROMIUM | | <0.005 | 0.011 | 0.019 | 0.016 | <0.008 | | | | |
| COBALT | | <0.005 | <0.008 | <0.008 | 0.015 | 0.041 | | | | |
| COPPER | | <0.003 | <0.003 | 0.003 | 0.007 | 0.004 | | | | |
| FLUORIDE | 4.87 | 0.82 | 0.62 | 0.64 | 1.2 | 0.6 | | | | |
| IRON | | 0.134 | 0.349 | 0.343 | 0.509 | 0.661 | | | | |
| LEAD | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | | | | |
| MANGANESE | | 0.004 | <0.002 | <0.002 | 0.001 | 0.005 | | | | |
| MERCURY | 0.308 | <0.0002 | 0.113 | 0.214 | 0.0134 | 0.0008 | | | | |
| MOLYBDENUM | | 0.018 | 0.01 | 0.02 | 0.032 | 0.034 | | | | |
| NICKEL | <0.04 | <0.017 | <0.02 | <0.02 | <0.016 | 0.017 | | | | |
| SELENIUM | 0.026 | 0.06 | <0.04 | <0.04 | <0.048 | 0.069 | | | | |
| SILVER | | <0.003 | <0.004 | <0.004 | <0.005 | 0.005 | | | | |
| THALLIUM | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | | | | |
| TIN | | <0.046 | <0.04 | <0.04 | <0.038 | <0.038 | | | | |
| VADADIUM | | 0.009 | <0.01 | <0.01 | 0.008 | 0.008 | | | | |
| ZINC | | 0.002 | 0.004 | 0.004 | 0.005 | 0.012 | | | | |
| | | | | | | | | | | |

# Table B-3
## Marigold Mine Meteoric Water Mobility Procedure Analyses

| LEACH SOLIDS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLE LOC. | Top Zone | 8-South | 8-South | Top Zone | 8-South | 8-South | 8-South | 8-South | Top Zone | Top Zone |
| SAMPLE TYPE | Leach | Leach | Leach | Leach | Leach (1st) | Leach (2nd) | Leach (3rd) | Leach (4th) | Leach (1st) | Leach (2nd) |
| SAMPLE NO. | G071-02 | G071-02 | G303-04L | G303-04L | E42464 | E42466 | E52340 | E52341 | E42470 | E42472 |
| DATE | 3/27/92 | 3/27/92 | 11/23/92 | 11/23/92 | 7/12/93 | 7/12/93 | 12/2/93 | 12/2/93 | 7/12/93 | 7/12/93 |
| CROSS REF | ABA-4 | ABA-6 | ABA-10 | ABA-12 | ABA-34 | ABA-35 | ABA-36 | ABA-37 | ABA-38 | ABA-39 |
| CONSTITUENT | | | | | | | | | | |
| pH | 7.59 | 8.01 | | | 6.8 | 6.9 | 8.2 | 8.1 | 7.5 | 6.9 |
| TDS | 163 | 121 | | | 86 | 106 | 119 | 108 | 215 | 227 |
| SULFATE | 7 | 6.2 | | | 18.3 | 19.3 | 24.1 | 18.3 | 44.7 | 28.9 |
| ALKALINITY | 23 | 42 | | | 56 | 62 | 76 | 66 | 62 | 63 |
| CHLORIDE | 36.24 | 113.4 | | | 1.7 | 1.8 | 7.5 | 3.7 | 26.7 | 39.7 |
| NITRATE | 0.024 | 0.49 | | | 0.47 | 0.34 | 1.15 | 1.33 | 0.64 | 2.61 |
| PHOSPHORUS | 0.181 | <0.1 | <0.25 | 0.125 | 0.17 | 0.15 | <0.07 | <0.07 | 0.03 | 0.07 |
| WAD CYANIDE | <0.005 | <0.005 | | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.06 |
| ALUMINUM | 0.678 | 0.209 | 0.024 | 0.754 | <0.01 | <0.01 | <0.02 | <0.02 | 0.02 | <0.01 |
| ANTIMONY | <0.05 | <0.05 | <0.05 | <0.05 | 0.002 | <0.001 | 0.004 | 0.002 | 0.01 | 0.002 |
| ARSENIC | <0.05 | <0.05 | <0.005 | 0.973 | 0.04 | <0.04 | 0.05 | 0.04 | 0.26 | 0.18 |
| BARIUM | 0.089 | 0.15 | 0.102 | 0.141 | 0.19 | 0.181 | 0.171 | 0.184 | 0.102 | 0.181 |
| CADMIUM | <0.005 | <0.005 | <0.005 | <0.005 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| CHROMIUM | 0.056 | 0.052 | <0.01 | <0.01 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 |
| COBALT | 0.022 | 0.022 | <0.015 | <0.015 | <0.002 | <0.002 | 0.004 | <0.003 | <0.002 | <0.002 |
| COPPER | 0.052 | 0.5 | <0.01 | <0.01 | 0.003 | 0.004 | <0.005 | <0.005 | 0.003 | 0.003 |
| FLUORIDE | <0.2 | <0.2 | | | 0.6 | 0.4 | 0.6 | 0.5 | 1.2 | 1.7 |
| IRON | 0.227 | 0.152 | <0.05 | 0.11 | <0.02 | <0.02 | <0.01 | <0.01 | <0.02 | <0.02 |
| LEAD | <0.025 | <0.025 | <0.01 | 0.017 | <0.001 | <0.001 | 0.001 | <0.001 | 0.002 | 0.001 |
| MANGANESE | 0.095 | 0.09 | <0.005 | 0.059 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| MERCURY | 0.0018 | 0.0051 | 0.0084 | 0.0406 | <0.0002 | 0.0011 | <0.0002 | <0.0002 | 0.01 | 0.23 |
| MOLYBDENUM | <0.005 | <0.008 | 0.048 | <0.015 | 0.02 | 0.012 | 0.016 | 0.009 | 0.015 | 0.018 |
| NICKEL | 0.106 | 0.111 | <0.025 | <0.025 | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| SELENIUM | <0.005 | <0.025 | <0.002 | <0.002 | <0.04 | <0.04 | 0.002 | 0.002 | <0.04 | <0.04 |
| SILVER | <0.02 | <0.02 | <0.05 | <0.05 | 0.002 | <0.002 | <0.003 | <0.003 | 0.002 | 0.002 |
| THALLIUM | 0.194 | 0.233 | <0.1 | <0.1 | <0.001 | <0.001 | 0.002 | <0.001 | <0.001 | 0.001 |
| TIN | 0.027 | 0.063 | <0.05 | <0.05 | <0.06 | <0.06 | <0.03 | <0.03 | <0.06 | <0.06 |
| VADADIUM | 0.016 | 0.012 | <0.01 | <0.01 | 0.004 | <0.003 | 0.007 | 0.005 | <0.003 | 0.006 |
| ZINC | 0.076 | 0.062 | <0.05 | <0.05 | 0.003 | 0.003 | <0.002 | <0.002 | 0.002 | <0.002 |

# Table B-3
## Marigold Mine Meteoric Water Mobility Procedure Analyses

| LEACH SOLIDS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLE LOC. | Top Zone | East Hill | Top Zone | 8-South | | | | | | |
| SAMPLE TYPE | Leach (4th) | Leach (4th) | Leach | Leach | | | | | | |
| SAMPLE NO. | E52346 | E52434 | Monitor Lab | Monitor Lab | | | | | | |
| DATE | 12/2/93 | 12/2/93 | 6/15/92 | 6/15/92 | | | | | | |
| CROSS REF | ABA-40 | ABA-41 | ABA-14 | ABA-16 | | | | | | |
| CONSTITUENT | | | | | | | | | | |
| pH | 7.9 | 8.1 | 7.6 | 8 | | | | | | |
| TDS | 224 | 1860 | 82 | 36 | | | | | | |
| SULFATE | 23.4 | 643 | 19.9 | 8.17 | | | | | | |
| ALKALINITY | 71 | 100 | 57.1 | 34.4 | | | | | | |
| CHLORIDE | 7.6 | 566 | 3.04 | 4.06 | | | | | | |
| NITRATE | 15 | 1.61 | 0.4 | 1 | | | | | | |
| PHOSPHORUS | <0.07 | <0.07 | 0.028 | 1.5 | | | | | | |
| WAD CYANIDE | <0.01 | <0.01 | | | | | | | | |
| ALUMINUM | 0.02 | 0.02 | | | | | | | | |
| ANTIMONY | 0.009 | 0.002 | | | | | | | | |
| ARSENIC | 0.6 | 0.8 | 0.148 | 0.031 | | | | | | |
| BARIUM | 0.167 | 0.021 | | | | | | | | |
| CADMIUM | <0.002 | <0.002 | | | | | | | | |
| CHROMIUM | <0.004 | 0.024 | | | | | | | | |
| COBALT | 0.004 | 0.004 | | | | | | | | |
| COPPER | <0.005 | <0.005 | | | | | | | | |
| FLUORIDE | 1.02 | 1.8 | 0.724 | 0.119 | | | | | | |
| IRON | <0.01 | <0.01 | | | | | | | | |
| LEAD | <0.001 | <0.001 | | | | | | | | |
| MANGANESE | <0.002 | <0.002 | | | | | | | | |
| MERCURY | 0.0023 | 0.0005 | <0.0005 | 0.0137 | | | | | | |
| MOLYBDENUM | 0.016 | 0.227 | | | | | | | | |
| NICKEL | <0.01 | 0.01 | <0.04 | <0.04 | | | | | | |
| SELENIUM | 0.002 | 0.003 | <0.005 | <0.005 | | | | | | |
| SILVER | <0.003 | <0.003 | | | | | | | | |
| THALLIUM | 0.001 | 0.002 | | | | | | | | |
| TIN | <0.03 | <0.03 | | | | | | | | |
| VADADIUM | 0.004 | <0.003 | | | | | | | | |
| ZINC | <0.002 | <0.002 | | | | | | | | |

## Table B-3
## Marigold Mine Meteoric Water Mobility Procedure Analyses

| 8 SOUTH WASTE | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLE LOC. | 8-South | 8-South | 8-South | 8-South | 8-South | 8-South | 8-South | 8-South | 8-South | 8-South |
| SAMPLE TYPE | Waste | Waste | Waste | Waste | Waste (1st) | Waste (2nd) | Waste (3rd) | Waste (4th) | Valmy | Antler |
| SAMPLE NO. | F346-02A | G071-02 | G303-04L | H006-04L | E42465 | E42467 | E52342 | E52543 | E76062 | E76063 |
| DATE | 1/7/92 | 3/27/92 | 4/23/92 | 2/3/93 | 7/12/93 | 7/12/93 | 12/2/93 | 12/2/93 | 12/5/94 | 12/5/94 |
| CROSS REF | ABA-1 | ABA-7 | ABA-9 | ABA-20 | ABA-24 | ABA-25 | ABA-26 | ABA-27 | ABA-46 | ABA-47 |
| CONSTITUENT | | | | | | | | | | |
| pH | 8.62 | 7.95 | 8.55 | 8.24 | 8.2 | 8.05 | 7.49 | 7.9 | 8 | 8.6 |
| TDS | 34 | 108 | 27 | 209 | 105 | 98 | 100 | 129 | 211 | 233 |
| SULFATE | 8 | 8 | 6 | 19.5 | 18.5 | 19.7 | 25.8 | 20.9 | 9.59 | 25.8 |
| ALKALINITY | 37 | 42 | 37.5 | 78 | 56 | 60 | 85 | 71 | 76 | 161 |
| CHLORIDE | 1.77 | 4.99 | 8.86 | 11 | 2.6 | 2 | 5 | 3 | 2.75 | 11.4 |
| NITRATE | 0.5 | 0.44 | 4.5 | 1.64 | 1.12 | 0.7 | 1.83 | 2.4 | 0.19 | 0.28 |
| PHOSPHORUS | 0.249 | 0.103 | <0.25 | <0.25 | 0.09 | 0.07 | <0.07 | <0.07 | <0.3 | <0.3 |
| WAD CYANIDE | <0.02 | <0.005 | <0.02 | <0.02 | <0.01 | <0.01 | <0.01 | <0.01 | <0.005 | <0.005 |
| ALUMINUM | 0.508 | 0.145 | 0.074 | <0.065 | <0.01 | <0.01 | <0.02 | <0.02 | <0.03 | <0.03 |
| ANTIMONY | 0.018 | <0.05 | <0.05 | <0.05 | <0.001 | 0.002 | <0.001 | 0.003 | 0.002 | 0.004 |
| ARSENIC | 0.124 | <0.05 | <0.05 | <0.005 | <0.04 | <0.04 | <0.04 | 0.06 | 0.23 | 0.11 |
| BARIUM | 0.044 | 0.127 | 0.279 | 0.178 | 0.189 | 0.164 | 0.17 | 0.203 | 0.342 | 0.212 |
| CADMIUM | <0.005 | <0.005 | <0.005 | <0.005 | <0.002 | <0.002 | <0.002 | <0.002 | <0.004 | <0.004 |
| CHROMIUM | <0.025 | 0.054 | 0.015 | 0.013 | <0.004 | 0.007 | 0.012 | <0.004 | <0.004 | <0.004 |
| COBALT | <0.007 | 0.023 | <0.01 | <0.015 | <0.002 | <0.002 | 0.003 | <0.003 | <0.008 | <0.008 |
| COPPER | <0.5 | 0.054 | <0.01 | <0.01 | 0.003 | 0.002 | <0.005 | <0.05 | <0.003 | <0.003 |
| FLUORIDE | <0.05 | <0.2 | 0.15 | 0.29 | 0.3 | 1.1 | 0.7 | 0.7 | 0.64 | 0.78 |
| IRON | 0.185 | 0.105 | 0.1 | <0.1 | <0.02 | <0.02 | <0.01 | <0.01 | <0.009 | <0.009 |
| LEAD | <0.025 | <0.025 | <0.01 | <0.01 | 0.001 | 0.001 | <0.001 | 0.001 | 0.001 | <0.001 |
| MANGANESE | <0.025 | 0.088 | <0.005 | <0.01 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| MERCURY | <0.001 | 0.0251 | 0.012 | 0.0045 | 0.0006 | 0.0005 | 0.0012 | <0.0002 | <0.0002 | <0.0002 |
| MOLYBDENUM | 0.056 | <0.008 | <0.01 | 0.029 | 0.005 | 0.02 | 0.029 | 0.016 | <0.01 | 0.02 |
| NICKEL | <0.015 | 0.104 | <0.025 | <0.025 | 0.02 | <0.01 | <0.01 | <0.01 | <0.02 | <0.02 |
| SELENIUM | <0.005 | <0.005 | <0.002 | <0.002 | <0.04 | <0.04 | 0.02 | 0.002 | <0.04 | <0.04 |
| SILVER | <0.025 | <0.02 | <0.05 | <0.05 | 0.002 | <0.002 | <0.003 | <0.003 | <0.004 | <0.004 |
| THALLIUM | <0.04 | 0.19 | 0.071 | <0.1 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| TIN | <0.08 | 0.044 | <0.05 | 0.1 | <0.06 | <0.06 | <0.03 | <0.03 | <0.04 | <0.04 |
| VADADIUM | <0.008 | 0.014 | <0.01 | <0.01 | <0.003 | 0.008 | 0.005 | 0.004 | <0.01 | <0.01 |
| ZINC | 0.016 | 0.064 | <0.05 | <0.05 | <0.002 | <0.002 | <0.002 | <0.002 | <0.004 | <0.004 |

## Table B-3
## Marigold Mine Meteoric Water Mobility Procedure Analyses

| 8 SOUTH WASTE | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| SAMPLE LOC. | 8-South | 8-South | | | | | | | | |
| SAMPLE TYPE | Battle | Waste | | | | | | | | |
| SAMPLE NO. | E76064 | Monitor Lab | | | | | | | | |
| DATE | 12/5/94 | 6/15/92 | | | | | | | | |
| CROSS REF | ABA-48 | ABA-17 | | | | | | | | |
| | | | | | | | | | | |
| CONSTITUENT | | | | | | | | | | |
| | | | | | | | | | | |
| pH | 8.5 | 7.6 | | | | | | | | |
| TDS | 180 | 68 | | | | | | | | |
| SULFATE | 18 | 9.92 | | | | | | | | |
| ALKALINITY | 65 | 50.2 | | | | | | | | |
| CHLORIDE | 3.08 | 6.08 | | | | | | | | |
| NITRATE | 0.05 | 0.9 | | | | | | | | |
| PHOSPHORUS | <0.3 | 0.02 | | | | | | | | |
| WAD CYANIDE | <0.005 | | | | | | | | | |
| | | | | | | | | | | |
| ALUMINUM | 0.03 | | | | | | | | | |
| ANTIMONY | 0.026 | | | | | | | | | |
| ARSENIC | 0.18 | 0.036 | | | | | | | | |
| BARIUM | 0.41 | | | | | | | | | |
| CADMIUM | <0.004 | | | | | | | | | |
| CHROMIUM | <0.004 | | | | | | | | | |
| COBALT | <0.008 | | | | | | | | | |
| COPPER | 0.004 | | | | | | | | | |
| FLUORIDE | 1.08 | 0.195 | | | | | | | | |
| IRON | <0.009 | | | | | | | | | |
| LEAD | 0.002 | | | | | | | | | |
| MANGANESE | 0.002 | | | | | | | | | |
| MERCURY | 0.0003 | 0.00946 | | | | | | | | |
| MOLYBDENUM | 0.04 | | | | | | | | | |
| NICKEL | <0.02 | <0.04 | | | | | | | | |
| SELENIUM | <0.04 | <0.005 | | | | | | | | |
| SILVER | <0.004 | | | | | | | | | |
| THALLIUM | <0.001 | | | | | | | | | |
| TIN | <0.04 | | | | | | | | | |
| VADADIUM | 0.01 | | | | | | | | | |
| ZINC | <0.004 | | | | | | | | | |
| | | | | | | | | | | |

# Table B-3
## Marigold Mine Meteoric Water Mobility Procedure Analyses

| TOP ZONE N WASTE | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLE LOC. | Top Zone | Top Zone | Top Zone | Top Zone | Top Zone | Top Zone | Top Zone | Top Zone | Top Zone | Top Zone |
| SAMPLE TYPE | Waste | Waste | Waste | Waste | Waste (1st) | Waste (2nd) | Waste (3rd) | Waste (4th) | Valmy | Valmy |
| SAMPLE NO. | F246-02 | G071-02 | G303-04L | H006-041L | E42471 | E42473 | E52344 | E52345 | E76065 | TAZ95-1 |
| DATE | 1/14/92 | 3/27/92 | 11/23/92 | 2/3/93 | 7/12/93 | 7/12/93 | 12/2/93 | 12/2/93 | 12/2/93 | 6/4/97 |
| CROSS REF | ABA-2 | ABA-5 | ABA-11 | ABA-22 | ABA-28 | ABA-29 | ABA-30 | ABA-31 | ABA-49 | ABA-62 |
| CONSTITUENT | | | | | | | | | | |
| pH | | 7.85 | | 7.72 | 7.1 | 7.3 | 8.1 | 7.8 | 8.2 | 8.25 |
| TDS | | 518 | | 267 | 183 | 293 | 329 | 132 | 179 | 102 |
| SULFATE | | 44 | | 7.2 | 36.7 | 52.9 | 92.4 | 15.9 | 21.1 | 15.6 |
| ALKALINITY | | 40 | | 74 | 93 | 72 | 124 | 71 | 88 | 45 |
| CHLORIDE | | 9.99 | | 14 | 3.3 | 71.7 | 24.9 | 4.1 | 8.84 | 8.1 |
| NITRATE | | 0.5 | | 0.76 | 0.37 | 2.61 | 0.65 | <0.01 | 0.33 | 1.55 |
| PHOSPHORUS | 0.068 | 0.252 | 0.288 | <0.25 | 0.15 | 0.07 | 0.13 | <0.07 | <0.3 | <0.18 |
| WAD CYANIDE | | <0.005 | | <0.02 | <0.01 | <0.01 | <0.01 | <0.01 | <0.005 | <0.01 |
| ALUMINUM | 0.113 | 0.49 | 1.665 | 4.692 | 0.43 | 0.03 | 0.09 | 0.06 | <0.03 | 0.142 |
| ANTIMONY | <0.025 | <0.05 | <0.05 | <0.05 | 0.007 | 0.002 | 0.004 | 0.008 | 0.01 | <0.003 |
| ARSENIC | 0.094 | 0.061 | 1.067 | 0.247 | 1.28 | 0.15 | 0.96 | 0.77 | 0.36 | 0.78 |
| BARIUM | <0.025 | 0.118 | 0.292 | 0.112 | 0.104 | 0.452 | 0.18 | 0.211 | 0.208 | 0.258 |
| CADMIUM | <0.025 | <0.005 | <0.005 | <0.005 | <0.002 | <0.002 | <0.002 | <0.002 | <0.004 | <0.0024 |
| CHROMIUM | <0.005 | 0.051 | 0.016 | 0.016 | 0.007 | 0.005 | <0.004 | <0.004 | <0.004 | <0.005 |
| COBALT | <0.007 | 0.023 | <0.015 | <0.015 | <0.002 | <0.002 | <0.03 | <0.003 | <0.008 | <0.005 |
| COPPER | <0.5 | 0.152 | 0.062 | <0.01 | 0.005 | 0.007 | <0.005 | <0.005 | <0.003 | 0.005 |
| FLUORIDE | | 0.3 | . | 0.48 | 2.3 | 1.8 | 2.4 | 1 | 1.62 | 1.6 |
| IRON | <0.15 | 0.259 | 0.29 | 0.26 | 0.1 | <0.02 | <0.01 | <0.01 | <0.009 | 0.031 |
| LEAD | <0.025 | <0.025 | <0.01 | 0.026 | 0.001 | 0.001 | <0.001 | <0.001 | 0.001 | <0.001 |
| MANGANESE | <0.025 | 0.115 | 0.045 | 0.013 | <0.002 | <0.002 | 0.003 | <0.002 | <0.002 | 0.034 |
| MERCURY | <0.001 | 0.0031 | 0.008 | 0.0021 | 0.0008 | 0.0049 | 0.0006 | 0.0004 | <0.0002 | <0.0002 |
| MOLYBDENUM | <0.008 | <0.008 | <0.01 | <0.01 | 0.063 | 0.021 | 0.027 | 0.007 | 0.01 | 0.064 |
| NICKEL | <0.015 | 0.121 | <0.025 | <0.025 | <0.01 | <0.01 | <0.01 | <0.01 | <0.02 | <0.017 |
| SELENIUM | <0.005 | <0.005 | <0.002 | <0.002 | <0.04 | <0.04 | 0.004 | 0.003 | <0.04 | <0.04 |
| SILVER | <0.025 | <0.02 | <0.05 | <0.05 | 0.003 | 0.003 | <0.003 | <0.003 | <0.004 | 0.007 |
| THALLIUM | <0.04 | 0.101 | <0.1 | <0.1 | 0.001 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| TIN | <0.08 | 0.097 | <0.05 | 0.089 | 0.07 | <0.06 | <0.03 | <0.03 | <0.04 | <0.046 |
| VADADIUM | <0.008 | 0.081 | 0.015 | <0.01 | 0.009 | 0.009 | 0.021 | <0.003 | 0.01 | <0.004 |
| ZINC | 0.005 | 0.739 | <0.05 | <0.05 | 0.003 | 0.002 | <0.002 | <0.002 | <0.004 | <0.002 |

# Table B-3
## Marigold Mine Meteoric Water Mobility Procedure Analyses

| TOP ZONE N WASTE | | | TOP ZONE S WASTE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLE LOC. | Top Zone | | Top Zone S | Top Zone S | Top Zone S | Top Zone S | | | | |
| SAMPLE TYPE | Waste | | Antler | Valmy | Antler | Valmy | | | | |
| SAMPLE NO. | Monitor Lab | | TZ96-1 | TZ96-2 | TZ97-A | TZ97-V | | | | |
| DATE | 6/15/92 | | 6/4/97 | 6/4/97 | 11/19/97 | 11/19/97 | | | | |
| CROSS REF | ABA-15 | | ABA-63 | ABA-64 | ABA-70 | ABA-71 | | | | |
| CONSTITUENT | | | | | | | | | | |
| pH | 8.2 | | 8.42 | 8.33 | 6.67 | 7.03 | | | | |
| TDS | 1480 | | 72 | 88 | 79 | 121 | | | | |
| SULFATE | 19.1 | | 17.4 | 30.2 | 15 | 13 | | | | |
| ALKALINITY | 67.8 | | 52.8 | 44.7 | 50 | 61.7 | | | | |
| CHLORIDE | 20.3 | | 2.2 | 18 | 3.7 | 5.7 | | | | |
| NITRATE | 2.6 | | 4.06 | 1.86 | 0.44 | 0.55 | | | | |
| PHOSPHORUS | <0.01 | | <0.18 | <0.18 | <0.11 | <0.11 | | | | |
| WAD CYANIDE | | | <0.01 | <0.01 | <0.01 | <0.01 | | | | |
| ALUMINUM | | | 0.061 | 0.059 | 0.05 | 0.119 | | | | |
| ANTIMONY | | | <0.003 | <0.003 | 0.004 | <0.003 | | | | |
| ARSENIC | 0.787 | | 0.09 | 0.3 | 0.08 | 0.25 | | | | |
| BARIUM | | | 0.186 | 0.112 | 0.149 | 0.255 | | | | |
| CADMIUM | | | <0.0024 | <0.0024 | <0.002 | <0.002 | | | | |
| CHROMIUM | | | <0.005 | <0.005 | <0.008 | 0.008 | | | | |
| COBALT | | | <0.005 | <0.005 | 0.006 | <0.003 | | | | |
| COPPER | | | 0.007 | 0.005 | <0.004 | <0.004 | | | | |
| FLUORIDE | 1.75 | | 0.4 | 0.8 | 0.2 | 0.8 | | | | |
| IRON | | | <0.024 | <0.024 | <0.019 | 0.031 | | | | |
| LEAD | | | <0.001 | <0.001 | <0.001 | 0.016 | | | | |
| MANGANESE | | | 0.003 | <0.002 | 0.005 | 0.004 | | | | |
| MERCURY | 0.0035 | | <0.0002 | <0.0002 | 0.0003 | 0.0005 | | | | |
| MOLYBDENUM | | | 0.059 | 0.032 | 0.021 | 0.021 | | | | |
| NICKEL | 0.07 | | <0.017 | <0.017 | <0.016 | <0.016 | | | | |
| SELENIUM | <0.005 | | <0.04 | <0.04 | <0.048 | <0.048 | | | | |
| SILVER | | | 0.006 | 0.004 | <0.005 | <0.005 | | | | |
| THALLIUM | | | <0.001 | <0.001 | <0.001 | <0.001 | | | | |
| TIN | | | <0.046 | <0.046 | 0.039 | 0.056 | | | | |
| VADADIUM | | | <0.004 | 0.012 | <0.007 | <0.007 | | | | |
| ZINC | | | <0.002 | <0.002 | <0.004 | 0.007 | | | | |

# Table B-3
## Marigold Mine Meteoric Water Mobility Procedure Analyses

| EAST HILL N WASTE | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLE LOC. | East Hill | East Hill | East Hill | East Hill | East Hill | East Hill | East Hill | East Hill | East Hill | East Hill |
| SAMPLE TYPE | Waste (3rd) | Waste (4th) | Leach (4th) | Havallah | Valmy | Antler | Havallah | Antler | Valmy | Antler |
| SAMPLE NO. | E52349 | E52350 | E52434 | E76066 | E76067 | E76068 | EH95-1 | EH95-2 | EH95-3 | EH96-1 |
| DATE | 12/2/93 | 12/2/93 | 12/2/93 | 12/5/94 | 12/5/94 | 12/5/94 | 6/4/97 | 6/4/97 | 6/4/97 | 6/4/97 |
| CROSS REF | ABA-32 | ABA-33 | ABA-41 | ABA-50 | ABA-51 | ABA-52 | ABA-57 | ABA-58 | ABA-59 | ABA-60 |
| CONSTITUENT | | | | | | | | | | |
| pH | 8.1 | 8.1 | 8.1 | 8.3 | 8.1 | 8.2 | 8.45 | 9.12 | 8.8 | 8.3 |
| TDS | 561 | 166 | 1860 | 309 | 150 | 173 | 1170 | 280 | 137 | 26 |
| SULFATE | 206 | 30.5 | 643 | 61.1 | 13.6 | 22.8 | 273 | 62.9 | 27.9 | 9.4 |
| ALKALINITY | 83 | 97 | 100 | 66 | 69 | 114 | 72.6 | 63.5 | 60 | 34.6 |
| CHLORIDE | 87.9 | 65.4 | 566 | 20.8 | 3.32 | 10.5 | 331 | 83.7 | 5.6 | 2.8 |
| NITRATE | 1.09 | 0.6 | 1.61 | 0.69 | 0.04 | 0.31 | 43.8 | 1.07 | 1.27 | 0.42 |
| PHOSPHORUS | <0.07 | <0.07 | <0.07 | <0.3 | <0.3 | <0.3 | 0.33 | 0.19 | <0.18 | <0.18 |
| WAD CYANIDE | <0.01 | <0.01 | <0.01 | <0.005 | <0.005 | <0.005 | <0.01 | <0.01 | <0.01 | <0.01 |
| ALUMINUM | 0.04 | <0.02 | 0.02 | 0.05 | <0.03 | 0.03 | 0.093 | 0.401 | 0.251 | 0.012 |
| ANTIMONY | <0.001 | <0.001 | 0.002 | 0.006 | 0.002 | 0.003 | <0.003 | <0.003 | <0.003 | <0.003 |
| ARSENIC | 0.4 | 0.23 | 0.8 | 0.69 | 0.22 | 0.07 | 0.57 | 0.17 | 0.89 | <0.04 |
| BARIUM | 0.046 | 0.062 | 0.021 | 0.278 | 0.387 | 0.125 | 0.087 | 0.188 | 0.234 | 0.173 |
| CADMIUM | <0.002 | <0.002 | <0.002 | <0.004 | <0.004 | <0.004 | <0.002 | <0.0024 | <0.0024 | <0.0024 |
| CHROMIUM | <0.004 | <0.004 | 0.024 | <0.004 | <0.004 | <0.004 | <0.005 | <0.005 | 0.005 | <0.005 |
| COBALT | <0.003 | <0.003 | 0.004 | <0.008 | <0.008 | <0.008 | <0.005 | <0.005 | <0.005 | <0.005 |
| COPPER | 0.006 | 0.007 | <0.005 | <0.003 | <0.003 | <0.003 | 0.008 | 0.009 | 0.009 | 0.007 |
| FLUORIDE | 1.3 | 1.4 | 1.8 | 3.01 | 0.55 | 0.67 | 1.4 | 0.6 | 1.6 | 0.2 |
| IRON | <0.01 | <0.01 | <0.01 | <0.009 | <0.009 | <0.009 | 0.027 | 0.017 | 0.056 | <0.024 |
| LEAD | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| MANGANESE | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | 0.006 | 0.022 | 0.017 | 0.002 |
| MERCURY | 0.0004 | 0.0003 | 0.0005 | 0.0003 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 |
| MOLYBDENUM | 0.034 | 0.023 | 0.227 | 0.03 | 0.01 | 0.04 | 0.08 | <0.014 | 0.045 | 0.026 |
| NICKEL | <0.01 | <0.01 | 0.01 | <0.02 | <0.02 | <0.02 | <0.017 | <0.017 | <0.017 | 0.019 |
| SELENIUM | 0.001 | 0.002 | 0.003 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 |
| SILVER | <0.003 | <0.003 | <0.003 | <0.004 | <0.004 | <0.004 | 0.011 | 0.009 | 0.011 | <0.008 |
| THALLIUM | 0.001 | 0.002 | 0.002 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| TIN | <0.03 | <0.03 | <0.03 | <0.04 | <0.04 | <0.04 | <0.046 | <0.046 | <0.046 | <0.046 |
| VADADIUM | 0.093 | 0.146 | <0.003 | 0.05 | <0.01 | <0.01 | 0.035 | 0.005 | 0.006 | <0.004 |
| ZINC | <0.002 | <0.002 | <0.002 | <0.004 | <0.004 | <0.004 | <0.002 | <0.002 | <0.002 | <0.002 |

# Table B-3
## Marigold Mine Meteoric Water Mobility Procedure Analyses

| EAST HILL N WASTE | | | | | EAST HILL S WASTE | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLE LOC. | East Hill | East Hill N | | | East Hill S | | | | | |
| SAMPLE TYPE | Valmy | Valmy | | | Valmy | | | | | |
| SAMPLE NO. | EH96-2 | EHN97-V | | | EHS97-V | | | | | |
| DATE | 6/4/97 | 11/19/97 | | | 11/19/97 | | | | | |
| CROSS REF | ABA-61 | ABA-68 | | | ABA-69 | | | | | |
| CONSTITUENT | | | | | | | | | | |
| pH | 8.2 | 6.64 | | | 7.69 | | | | | |
| TDS | 122 | 98 | | | 329 | | | | | |
| SULFATE | 12 | 8.6 | | | 70.9 | | | | | |
| ALKALINITY | 43.1 | 52.1 | | | 87.6 | | | | | |
| CHLORIDE | 2.2 | 2 | | | 52.6 | | | | | |
| NITRATE | 0.59 | 0.65 | | | 2.25 | | | | | |
| PHOSPHORUS | 0.24 | <0.11 | | | <0.11 | | | | | |
| WAD CYANIDE | <0.01 | <0.01 | | | <0.01 | | | | | |
| ALUMINUM | 0.242 | 0.049 | | | 0.126 | | | | | |
| ANTIMONY | <0.003 | <0.003 | | | 0.008 | | | | | |
| ARSENIC | 0.13 | 0.19 | | | 0.43 | | | | | |
| BARIUM | 0.299 | 0.103 | | | 0.145 | | | | | |
| CADMIUM | <0.0024 | <0.002 | | | <0.002 | | | | | |
| CHROMIUM | <0.005 | <0.008 | | | <0.008 | | | | | |
| COBALT | <0.005 | <0.004 | | | <0.003 | | | | | |
| COPPER | 0.013 | <0.004 | | | <0.004 | | | | | |
| FLUORIDE | 0.7 | 0.4 | | | 1.5 | | | | | |
| IRON | 0.028 | <0.019 | | | 0.031 | | | | | |
| LEAD | <0.001 | <0.001 | | | <0.001 | | | | | |
| MANGANESE | 0.011 | 0.002 | | | 0.007 | | | | | |
| MERCURY | <0.0002 | 0.0017 | | | 0.0004 | | | | | |
| MOLYBDENUM | 0.059 | 0.023 | | | 0.083 | | | | | |
| NICKEL | <0.017 | <0.016 | | | <0.016 | | | | | |
| SELENIUM | <0.04 | <0.048 | | | <0.048 | | | | | |
| SILVER | 0.015 | <0.005 | | | <0.005 | | | | | |
| THALLIUM | <0.001 | <0.001 | | | <0.001 | | | | | |
| TIN | <0.046 | <0.038 | | | 0.096 | | | | | |
| VADADIUM | <0.004 | <0.007 | | | 0.02 | | | | | |
| ZINC | <0.002 | <0.004 | | | <0.004 | | | | | |

# Table B-3
## Marigold Mine Meteoric Water Mobility Procedure Analyses

| RED ROCKS N WASTE | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLE LOC. | Red Rock | Red Rock | Red Rock | Red Rock | | | | | | |
| SAMPLE TYPE | Battle | Antler | Antler | Valmy | | | | | | |
| SAMPLE NO. | E76069 | E76070 | RR95-1 | RR95-2 | | | | | | |
| DATE | 12/5/94 | 12/5/94 | 6/4/97 | 6/4/97 | | | | | | |
| CROSS REF | ABA-53 | ABA-54 | ABA-65 | ABA-66 | | | | | | |
| CONSTITUENT | | | | | | | | | | |
| pH | 8.3 | 8.3 | 8.31 | 8.02 | | | | | | |
| TDS | 217 | 268 | 116 | 35 | | | | | | |
| SULFATE | 27.3 | 36.1 | 58.5 | 16.1 | | | | | | |
| ALKALINITY | 121 | 131 | 47.4 | 42.2 | | | | | | |
| CHLORIDE | 18.4 | 24.5 | 10.5 | 3.5 | | | | | | |
| NITRATE | 1.29 | 1.89 | 2.04 | 1.44 | | | | | | |
| PHOSPHORUS | <0.3 | <0.3 | <0.18 | 0.23 | | | | | | |
| WAD CYANIDE | <0.005 | <0.005 | <0.01 | <0.01 | | | | | | |
| ALUMINUM | <0.03 | 0.04 | 0.074 | 0.075 | | | | | | |
| ANTIMONY | 0.008 | 0.002 | <0.003 | <0.003 | | | | | | |
| ARSENIC | 0.1 | 0.08 | <0.04 | 0.38 | | | | | | |
| BARIUM | 0.127 | 0.124 | 0.077 | 0.071 | | | | | | |
| CADMIUM | <0.004 | <0.004 | <0.0024 | <0.0024 | | | | | | |
| CHROMIUM | <0.004 | <0.004 | <0.005 | <0.005 | | | | | | |
| COBALT | <0.008 | <0.008 | <0.005 | <0.005 | | | | | | |
| COPPER | <0.003 | <0.003 | 0.007 | 0.007 | | | | | | |
| FLUORIDE | 0.66 | 1.15 | 0.4 | 0.8 | | | | | | |
| IRON | <0.009 | <0.009 | <0.024 | <0.024 | | | | | | |
| LEAD | <0.001 | 0.001 | <0.001 | <0.001 | | | | | | |
| MANGANESE | <0.002 | <0.002 | <0.002 | <0.002 | | | | | | |
| MERCURY | <0.0002 | <0.0002 | <0.0002 | 0.0004 | | | | | | |
| MOLYBDENUM | 0.03 | 0.03 | 0.034 | 0.044 | | | | | | |
| NICKEL | <0.02 | <0.02 | <0.017 | <0.017 | | | | | | |
| SELENIUM | <0.04 | <0.04 | 0.06 | <0.04 | | | | | | |
| SILVER | <0.004 | <0.004 | 0.009 | 0.008 | | | | | | |
| THALLIUM | <0.001 | <0.001 | <0.001 | <0.001 | | | | | | |
| TIN | <0.04 | <0.04 | 0.061 | <0.046 | | | | | | |
| VADADIUM | <0.01 | <0.01 | 0.004 | <0.004 | | | | | | |
| ZINC | <0.004 | <0.004 | <0.002 | <0.002 | | | | | | |

## Table B-3
## Marigold Mine Meteoric Water Mobility Procedure Analyses

| 8 NORTH WASTE | | |
|---|---|---|
| | | |
| SAMPLE LOC. | 8 North | 8 North |
| SAMPLE TYPE | Antler Peak | Havallah |
| SAMPLE NO. | 192049 | 192050 |
| DATE | Dec-98 | Dec-98 |
| CROSS REF | ABA-85 | ABA-86 |
| | | |
| CONSTITUENT | | |
| | | |
| pH | 7.86 | 7.68 |
| TDS | 281 | 288 |
| SULFATE | 28.2 | 24 |
| ALKALINITY | 86.4 | 81.5 |
| CHLORIDE | 28.4 | 27 |
| NITRATE | 0.5 | 0.36 |
| PHOSPHORUS | 0.11 | 0.11 |
| WAD CYANIDE | 0.01 | 0.01 |
| | | |
| ALUMINUM | <0.037 | <0.037 |
| ANTIMONY | <0.002 | <0.002 |
| ARSENIC | <0.04 | <0.04 |
| BARIUM | 0.349 | 0.213 |
| CADMIUM | <0.002 | <0.002 |
| CHROMIUM | <0.008 | <0.008 |
| COBALT | 0.006 | 0.004 |
| COPPER | 0.004 | 0.006 |
| FLUORIDE | 4.1 | 3.2 |
| IRON | 0.02 | 0.019 |
| LEAD | <0.001 | <0.001 |
| MANGANESE | 0.094 | 0.037 |
| MERCURY | 0.0002 | 0.0002 |
| MOLYBDENUM | 0.023 | 0.011 |
| NICKEL | <0.016 | <0.016 |
| SELENIUM | <0.048 | <0.048 |
| SILVER | <0.005 | <0.005 |
| THALLIUM | <0.001 | <0.001 |
| TIN | <0.038 | <0.038 |
| VADADIUM | <0.007 | <0.007 |
| ZINC | 0.007 | 0.004 |
| | | |

# Table B-3
## Marigold Mine Meteoric Water Mobility Procedure Analyses

| 5 NORTH WASTE | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |
| SAMPLE LOC. | 5 North | 5 North | 5 North | 5 North | | | | | | | |
| SAMPLE TYPE | Antler Peak | Battle Fm | Edna Mtn | Havallah | | | | | | | |
| SAMPLE NO. | 192045 | 192046 | 192047 | 192048 | | | | | | | |
| DATE | Dec-98 | Dec-98 | Dec-98 | Dec-98 | | | | | | | |
| CROSS REF | ABA-81 | ABA-82 | ABA-83 | ABA-84 | | | | | | | |
| | | | | | | | | | | | |
| CONSTITUENT | | | | | | | | | | | |
| | | | | | | | | | | | |
| pH | 7.22 | 7.49 | 7.76 | 7.56 | | | | | | | |
| TDS | 489 | | 408 | 351 | | | | | | | |
| SULFATE | 91.5 | 29.5 | 21 | 17.9 | | | | | | | |
| ALKALINITY | 94.1 | 230 | 113 | 103 | | | | | | | |
| CHLORIDE | 30 | 54.2 | 31.2 | 38.8 | | | | | | | |
| NITRATE | 0.35 | 0.89 | 0.48 | 0.65 | | | | | | | |
| PHOSPHORUS | 0.18 | <0.11 | 0.21 | 0.18 | | | | | | | |
| WAD CYANIDE | <0.01 | | <0.01 | <0.01 | | | | | | | |
| | | | | | | | | | | | |
| ALUMINUM | <0.037 | 0.045 | <0.037 | <0.037 | | | | | | | |
| ANTIMONY | <0.002 | <0.002 | <0.002 | <0.002 | | | | | | | |
| ARSENIC | <0.04 | <0.04 | <0.04 | <0.04 | | | | | | | |
| BARIUM | 0.22 | 0.254 | 0.587 | 0.481 | | | | | | | |
| CADMIUM | 0.007 | <0.002 | 0.004 | 0.003 | | | | | | | |
| CHROMIUM | <0.008 | 0.008 | <0.008 | <0.008 | | | | | | | |
| COBALT | 0.011 | 0.005 | 0.008 | 0.006 | | | | | | | |
| COPPER | 0.011 | 0.006 | 0.006 | 0.006 | | | | | | | |
| FLUORIDE | <0.5 | 1.6 | <0.5 | <0.5 | | | | | | | |
| IRON | 0.072 | 0.026 | <0.019 | <0.019 | | | | | | | |
| LEAD | <0.001 | <0.001 | <0.001 | <0.001 | | | | | | | |
| MANGANESE | 0.013 | 0.017 | 0.053 | 0.02 | | | | | | | |
| MERCURY | <0.0004 | 0.0049 | 0.0067 | 0.0074 | | | | | | | |
| MOLYBDENUM | 0.067 | 0.105 | 0.011 | 0.013 | | | | | | | |
| NICKEL | <0.016 | <0.016 | <0.016 | <0.016 | | | | | | | |
| SELENIUM | 0.132 | <0.048 | <0.048 | <0.048 | | | | | | | |
| SILVER | 0.005 | <0.005 | <0.005 | <0.005 | | | | | | | |
| THALLIUM | <0.001 | 0.012 | <0.001 | <0.001 | | | | | | | |
| TIN | <0.038 | <0.038 | <0.038 | <0.038 | | | | | | | |
| VADADIUM | 0.009 | <0.007 | <0.007 | <0.007 | | | | | | | |
| ZINC | 0.017 | 0.034 | 0.02 | 0.019 | | | | | | | |
| Note: pH is measured in standard units; all other constituents are measured in mg/l. | | | | | | | | | | | |

## Table B-4
## Marigold Mine Summary of Static Acid-Base Accounting Test Results for Proposed 8-North and 5-North Pits

| LITHOLOGIC UNIT | OTAL SULFU (weight %) | PYRITIC SULFU (weight %) | NET NEUTRALIZIN POTENTIAL (NNP) (T/Kt) | ANP/AGP | PASTE pH | PERCENT SAMPLES LESS THAN 20 T/kT NET NEUTRALIZING POTENTIAL |
|---|---|---|---|---|---|---|
| **5-NORTH PIT** | | | | | | |
| Havallah Formation | <0.01 to 0.11 | < 0.01 to 0.06 | 3.2 to 104 | 3.5 to 210 | .0 or greate | 50% of samples |
| Edna Mountain Formation | <0.01 to 2.57 | < 0.01 to 0.87 | 107 to 613 | 10.3 to 2043 | .0 or greater | |
| Antler Peak Formation | 0.01 to 0.89 | < 0.01 to 0.59 | 388 to 730 | 18.9 to 2433 | .0 or greater | |
| Battle Formation | < 0.01 | < 0.01 | 76 to 787 | 253 to 2623 | .0 or greater | |
| Valmy Formation | 0.01 to 0.05 | < 0.01 to 0.02 | .7 to 10.1 | 2.3 to 28 | .0 or greate | 100% of samples; 16.7% with ANP/AGP < 3:1 |
| **8-NORTH PIT** | | | | | | |
| Havallah Formation | 0.03 to 0.53 | 0.01 to 0.28 | -4.6 to 64.8 | 0.5 to 99.5 | .5 or greate | 50% of samples; 14.3% with ANP/AGP less than 3:1 |
| Edna Mountain Formation | 0.05 to 0.45 | 0.01 to 0.13 | 10 to 115 | 3.5 to 42.7 | .5 or greate | 50% of samples |

## Table B-5
## Marigold Mine Static Acid-Base Accounting Data for Proposed 8-North and 5-North Pits

| SAMPLE NUMBER | ITHOLOGI UNIT | TOTAL SULFUR (wt %) | SULFATE SULFUR (wt %) | ON-EXTRAC SULFUR (wt %) | PYRITIC SULFUR (wt %) | ACID GENERATING POTENTIAL (AGP) (T/kT CaCO3) | CID NEUTRALIZIN POTENTIAL (ANP) (T/kT CaCO3) | NET NEUTRALIZIN POTENTIAL (NNP) (T/kT CaCO3) | ANP/AGP | PASTE pH |
|---|---|---|---|---|---|---|---|---|---|---|
| **5-NORTH PIT** | | | | | | | | | | |
| 00-ABA-1 | Havallah | 0.07 | 0.03 | <.01 | 0.04 | 1.3 | 4.5 | **3.2** | 3.5 | 8.12 |
| 00-ABA-1 | Havallah | 0.06 | 0.03 | <.01 | 0.03 | 0.9 | 4.4 | **3.5** | 4.9 | |
| 00ABA-2 | Havallah | 0.02 | 0.02 | <.01 | <.01 | 0.3 | 3.2 | **2.9** | 10.7 | 7.88 |
| 00-ABA-3 | Havallah | <.01 | <.01 | <.01 | <.01 | 0.3 | 4.1 | **3.8** | 13.7 | 7.98 |
| 00-ABA-4 | Edna | 0.08 | <.01 | 0.03 | 0.05 | 1.6 | 109 | 107.4 | 68.1 | 8.25 |
| 00-ABA-5 | Edna | 0.58 | <.01 | 0.13 | 0.45 | 14.1 | 269 | 254.9 | 19.1 | 8.46 |
| 00-ABA-6 | Edna | <.01 | <.01 | <.01 | <.01 | 0.3 | 365 | 364.7 | 1216.7 | 8.61 |
| 00-ABA-7 | Antler | <.01 | <.01 | <.01 | <.01 | 0.3 | 388 | 387.7 | 1293.3 | 8.55 |
| 00-ABA-8 | Antler | 0.089 | <.01 | 0.3 | 0.59 | 18.4 | 347 | 328.6 | 18.9 | 8.47 |
| 00-ABA-9 | Antler | 0.29 | <.01 | 0.08 | 0.21 | 6.6 | 461 | 454.4 | 69.8 | 8.54 |
| 00-ABA-10 | Battle | <.01 | <.01 | <.01 | <.01 | 0.3 | 456 | 455.7 | 1520.0 | 8.58 |
| 00-ABA-11 | Battle | <.01 | <.01 | <.01 | <.01 | 0.3 | 441 | 440.7 | 1470.0 | 8.54 |
| 00-ABA-12 | Battle | <.01 | <.01 | <.01 | <.01 | 0.3 | 76 | 75.7 | 253.3 | 8.13 |
| 00-ABA-13 | Valmy | <.01 | <.01 | <.01 | <.01 | 0.3 | 2.5 | **2.2** | 8.3 | 8.32 |
| 00-ABA-14 | Valmy | <.01 | <.01 | <.01 | <.01 | 0.3 | 0.7 | **0.4** | **2.3** | 8.19 |
| 00-ABA-15 | Valmy | <.01 | <.01 | <.01 | <.01 | 0.3 | 8.4 | **8.1** | 28.0 | 8.36 |
| 00-ABA-16 | Havallah | 0.11 | 0.06 | <.01 | 0.05 | 1.6 | 104 | 102.4 | 65.0 | 8.36 |
| 00-ABA-16 | Havallah | 0.11 | 0.08 | <.01 | 0.03 | 0.9 | 105 | 104.1 | 116.7 | |
| 00-ABA-17 | Havallah | 0.02 | 0.01 | <.01 | 0.01 | 0.3 | 63.2 | 62.9 | 210.7 | 8.21 |
| 00-ABA-18 | Havallah | 0.06 | <.01 | <.01 | 0.06 | 1.9 | 57.4 | 55.5 | 30.2 | 8.25 |
| 00-ABA-19 | Edna | 0.11 | <.01 | <.01 | 0.11 | 3.4 | 310 | 306.6 | 91.2 | 8.42 |
| 00-ABA-20 | Edna | 2.57 | 0.56 | 1.14 | 0.87 | 27.2 | 280 | 252.8 | 10.3 | 8.45 |
| 00-ABA-21 | Edna | 0.03 | 0.03 | <.01 | <.01 | 0.3 | 613 | 612.7 | 2043.3 | 8.62 |
| 00-ABA-22 | Antler | <.01 | <.01 | <.01 | <.01 | 0.3 | 730 | 729.7 | 2433.3 | 8.91 |
| 00-ABA-23 | Antler | <.01 | <.01 | <.01 | <.01 | 0.3 | 567 | 566.7 | 1890.0 | 8.75 |
| 00-ABA-24 | Antler | 0.13 | 0.06 | 0.01 | 0.06 | 1.9 | 414 | 412.1 | 217.9 | 8.73 |
| 00-ABA-25 | Battle | <.01 | <.01 | <.01 | <.01 | 0.3 | 133 | 132.7 | 443.3 | 8.88 |
| 00-ABA-26 | Battle | <.01 | <.01 | <.01 | <.01 | 0.3 | 440 | 439.7 | 1466.7 | 8.35 |
| 00-ABA-27 | Battle | <.01 | <.01 | <.01 | <.01 | 0.3 | 787 | 786.7 | 2623.3 | 8.46 |
| 00-ABA-28 | Valmy | 0.05 | 0.03 | <.01 | 0.02 | 0.6 | 10.1 | **9.5** | 16.8 | 8.21 |
| 00-ABA-29 | Valmy | 0.03 | 0.03 | <.01 | <.01 | 0.3 | 3.4 | **3.1** | 11.3 | 8.28 |
| 00-ABA-30 | Valmy | 0.05 | 0.03 | <.01 | 0.02 | 0.6 | 3 | **2.4** | 5.0 | 8.1 |
| **8-NORTH PIT** | | | | | | | | | | |
| 00-ABA-31 | Havallah | 0.16 | 0.05 | 0.02 | 0.09 | 2.8 | 38.1 | 35.3 | 13.6 | 7.81 |
| 00-ABA-31 | Havallah | 0.14 | 0.02 | 0.02 | 0.1 | 3.1 | 40 | 36.9 | 12.9 | |
| 00-ABA-32 | Havallah | 0.11 | 0.05 | <.01 | 0.06 | 1.9 | 189 | 187.1 | 99.5 | 8.16 |
| 00-ABA-33 | Havallah | 0.17 | 0.04 | <.01 | 0.013 | 4.1 | 68.9 | 64.8 | 16.8 | 8.1 |
| 00-ABA-34 | Edna | 0.2 | 0.08 | 0.03 | 0.09 | 2.8 | 118 | 115.2 | 42.1 | 8.28 |
| 00-ABA-35 | Edna | 0.19 | 0.07 | <.01 | 0.12 | 3.8 | 97 | 93.2 | 25.5 | 8.29 |
| 00-ABA-36 | Edna | 0.45 | 0.13 | 0.2 | 0.12 | 3.8 | 82 | 78.2 | 21.6 | 8.18 |
| 00-ABA-37 | Havallah | 0.04 | 0.02 | <.01 | 0.02 | 0.6 | 5.8 | **5.2** | 9.7 | 7.99 |
| 00-ABA-38 | Havallah | 0.03 | 0.02 | <.01 | 0.01 | 0.3 | 3.7 | **3.4** | 12.3 | 8.01 |
| 00-ABA-39 | Havallah | 0.53 | 0.09 | 0.16 | 0.28 | 8.8 | 4.2 | **-4.6** | **0.5** | 7.82 |
| 00-ABA-40 | Edna | 0.16 | 0.12 | <.01 | 0.04 | 1.3 | 12 | **10.7** | 9.2 | 7.51 |
| 00-ABA-41 | Edna | 0.05 | 0.03 | 0.01 | 0.01 | 0.3 | 12.8 | **12.5** | 42.7 | 7.69 |
| 00-ABA-42 | Edna | 0.25 | 0.07 | 0.05 | 0.13 | 4.1 | 14.1 | **10** | 3.4 | 7.68 |

# Table B-6
## Groundwater Quality
## Marigold Mine Area

| WELL NAME AND WATER DEPTH | Sample Date | LOCATION Northing | Easting | pH | TDS | SO4 | Cl | Nitrate | Na | K | Ca | Mg | HCO3 | F | Water Level Date | Level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **VALMY POWER PLANT WELLS** | | | | | | | | | | | | | | | | |
| | | (T-R-S-qtr/qtr) | | | | | | | | | | | | | | |
| **Test Hole #2** (265-286 feet) | 10/3/75 | (35-44-17ad) | | 9.44 | 433 | 35.5 | 24.5 | 2.57 | 132.5 | 3.24 | 0.5 | 0.08 | 109 | | | |
| **Test Hole #2** (481-491 feet) | 9/19/75 | (35-44-17ad) | | 9.21 | 1318 | 134 | 154 | 0.13 | 502 | 6.69 | 0.63 | 0.41 | 572 | | | |
| **Test Hole #2** (601-622 feet) | 10/1/75 | (35-44-17ad) | | 8.8 | 1416 | 146 | 216 | 0.04 | 538 | 5.02 | 0.32 | 0.14 | 626 | | | |
| **Test Hole #3** (144-196 feet) | 10/30/75 | (34-45-25cc) | | 7.8 | 238 | 57 | 31.6 | 1.13 | 53 | 2.15 | 21.2 | 7.2 | 125.4 | | | |
| **Test Hole #3** (410-430 feet) | 10/29/75 | (34-45-25cc) | | 8.72 | 240 | 17.7 | 41.2 | 1.24 | 90 | 0.78 | 1.6 | 0.35 | 127.1 | | | |
| **Test Hole #3** (560-600 feet) | 10/24/75 | (34-45-25cc) | | 7.6 | 1745 | 413 | 188 | 0.09 | 630 | 7.5 | 22.7 | 13 | 1122 | | | |
| **Test Hole #4** (410-450 feet) | 11/15/75 | (33-44-9cc) | | 8.95 | 282 | 45 | 12.7 | 4.7 | 72 | 5 | 6 | 0.27 | 102.6 | | | |
| **Test Hole #7** (248-311 feet) | 12/17/75 | (34-43-17aa) | | 7.14 | 1433 | 222 | 80.8 | 0.04 | 490 | 40 | 37 | 10.1 | 1136 | | | |
| **Test Hole #8** (442-483 feet) | 1/6/76 | (33-44-27dc) | | 8 | 119 | 45.8 | 15.4 | 0.04 | 40.5 | 4.8 | 21.3 | 5.77 | 125.9 | | | |
| **Test Hole #9** (352-392 feet) | 1/28/76 | (33-43-1cc) | | 8.2 | 420 | 90 | 52.9 | 1.5 | 107.5 | 4.9 | 20 | 7.5 | 208 | | | |
| **MARIGOLD BEDROCK WATER WELLS** | | | | | | | | | | | | | | | | |
| **WW-1** | 12/18/96 | 35934 | 25963 | | | 53.2 | 25.5 | 0.22 | 21.1 | 2.41 | 48.2 | 15.5 | 140 | 0.2 | Nov-96 | 4395 |
| | 12/18/91 | | | 7.84 | 243 | 31 | 23.04 | 0.43 | 24.03 | 2.52 | 46.7 | 13.1 | 161 | 1.76 | | |
| **WW-2** | 12/18/96 | 30669 | 24836 | | | 50.4 | 26.8 | 0.27 | 22.8 | 2.31 | 46.6 | 14.4 | 142 | 0.2 | Nov-96 | 4392 |
| | 12/27/91 | | | 7.34 | 255 | 33.5 | 19.5 | 0.37 | 21.2 | 1.19 | 45.3 | 14.14 | 144 | 0.07 | | |
| **WW-3** | 12/18/96 | 25645 | 23880 | | | 50.1 | 27.9 | 0.33 | 22.5 | 2.04 | 47.9 | 14 | 145 | 0.2 | Jul-94 | 4410.4 |
| | 12/27/91 | | | 7.3 | 244 | 33.5 | 15.95 | 0.25 | 22.27 | 1.2 | 46.24 | 14.86 | 141 | 0.06 | | |
| **NM-028** | 5/27/86 | 23601 | 19799 | | | 12 | 21 | | 18 | 2.1 | 31 | 9 | 120 | <.1 | | |
| **NM-030** | 5/30/86 | 24386 | 19200 | | | 29 | 17 | | 24 | 1.8 | 36 | 8 | 140 | <.1 | | |

Sources: Marigold 1997 Annual Report
JBR Baseline Report, 1998
Guyton 1977a

# Table B-6
## Groundwater Quality
## Marigold Mine Area

| WELL NAME | Sample Date | LOCATION | | pH | TDS | SO4 | Cl | Nitrate | Na | K | Ca | Mg | HCO3 | F | Water Level | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Northing | Easting | | | | | | | | | | | | Date | Level |
| **MARIGOLD ALLUVIAL MONITOR WELLS** | | | | | | | | | | | | | | | | |
| TDOH-6 | 3/8/95 | 24123 | 26072 | 7 | 257 | 49.3 | 23.7 | | 24.2 | 6.1 | 46.5 | 15.6 | 123 | 0.1 | Dec-95 | 4421.9 |
| TDOH-12L | 11/4/97 | 24522 | 25935 | 6.79 | 313 | 13.2 | 99.4 | 3.35 | 22 | 1.9 | 52.8 | 15.3 | 80.8 | 0.2 | 6/10/98 | 4391.5 |
| TDOH-12U | 11/19/96 | 24502 | 25901 | 6.59 | 478 | 15.2 | 196 | 8.33 | 28.4 | 3.95 | 69.6 | 20.9 | 56.8 | 0.2 | Nov-96 | 4404.7 |
| TDOH-15 | 3/9/95 | 24479 | 26130 | 7.12 | 231 | 10.6 | 50.8 | | 18 | 2.91 | 35.5 | 10.8 | 98.4 | 0.18 | Jun-98 | 4404.7 |
| TDOH-16 | 11/19/96 | 24319 | 26368 | 7.73 | 291 | 67.4 | 24.6 | 0.17 | 34.4 | 3.44 | 56.2 | 14.9 | 157 | 0.2 | Jun-98 | 4398.2 |
| TDOH-17 | 10/9/96 | 23912 | 26511 | 8.04 | 276 | 70.3 | 23.5 | 0.31 | 27.1 | 3.73 | 55.8 | 15.8 | 149 | 0.3 | Jun-98 | 4394.4 |
| TDOH-18L | 11/4/97 | 24098 | 26443 | 7.31 | 291 | 60 | 33.1 | 0.84 | 30 | 3.4 | 54.3 | 18.3 | 162 | 0.4 | Jun-98 | 4385.6 |
| TDOH-18U | 11/4/97 | 24098 | 26443 | 7.83 | 326 | 70.6 | 23.5 | 0.29 | 71.4 | 13.1 | 27.8 | 15.2 | 240 | 0.6 | 6/10/98 | 4386.01 |
| TDOH-19L | 11/4/97 | 24484 | 26104 | 7.48 | 291 | 70.7 | 22.8 | 0.13 | 26.4 | 1.5 | 52.7 | 13.9 | 179 | 0.3 | 6/10/98 | 4384.7 |
| TDOH-19U | 11/4/97 | 24484 | 26104 | 7.82 | 265 | 28.5 | 44.1 | 0.55 | 66.5 | 9.6 | 28.4 | 12.7 | 215 | 0.4 | 6/10/98 | 4389.5 |
| TDOH-20L | 11/4/97 | 24383 | 25083 | 7.39 | 196 | 24.5 | 21.8 | 0.24 | 19.9 | 2.7 | 39.7 | 10.5 | 129 | 0.3 | 6/10/98 | 4387.4 |
| TDOH-20U | 11/4/97 | 24383 | 25083 | 8.1 | 410 | 59.9 | 28.5 | 0.14 | 130 | 11.1 | 13.1 | 7.11 | 239 | 1 | 6/10/98 | 4392.5 |
| **MARIGOLD PERCHED AQUIFER MONITOR WELLS** | | | | | | | | | | | | | | | | |
| TDMP-1 | 11/4/97 | 24221 | 25945 | 6.4 | 715 | 23.2 | 333 | 4.85 | 39.3 | 3.1 | 126 | 32.6 | 28.2 | 0.1 | 6/10/98 | 4542.2 |
| TDMP-2 | 11/4/97 | 23956 | 26280 | 6.24 | 1030 | 15.9 | 433 | 27.9 | 51.3 | 4 | 165 | 43.5 | 8.6 | 0.1 | 6/10/98 | 45644.7 |
| TDOH-1 | 11/4/97 | 24282 | 25866 | 6.42 | 719 | 36.5 | 311 | 8.67 | 34.1 | 2.7 | 130 | 33.8 | 22.8 | 0.1 | 6/10/98 | 4543.6 |
| TDOH-2 | 11/4/97 | 24159 | 26024 | 6.3 | 783 | 15.7 | 383 | 8.64 | 47.5 | 3.4 | 127 | 32.5 | 12 | 0.1 | 6/10/98 | 4541.4 |
| TDOH-3 | 11/4/97 | 24310 | 26022 | 6.64 | 519 | 8.2 | 267 | 3.65 | 34.2 | 3.3 | 99.1 | 25.8 | 24.2 | 0.1 | 6/10/98 | 4530.8 |
| TDOH-4 | 11/4/97 | 24407 | 25711 | 6.39 | 762 | 23.9 | 329 | 11.9 | 38.8 | 2.8 | 133 | 34.7 | 21.4 | 0.1 | 6/10/98 | 4531.8 |
| TDOH-5 | 11/4/97 | 24246 | 26099 | 6.92 | 309 | 10.7 | 112 | | 26.6 | 2.3 | 42.2 | 11.4 | 16.1 | 0.2 | 6/10/98 | 4522.9 |
| TDOH-7 | 5/6/93 | 24141 | 25590 | 7.55 | 2060 | 385 | 758 | | 178 | 8.6 | 430 | 87 | | 0.22 | 6/10/98 | |
| TDOH-8 | 8/7/97 | 23303 | 27087 | 7.07 | 466 | 9.4 | 158 | 2.54 | 25.4 | 3.3 | 66.3 | 13 | 28 | 0.2 | 6/10/98 | 4476.2 |
| **TAILINGS DAM** | | | | | | | | | | | | | | | | |
| PZ-1 | 3/6/97 | 24167 | 25551 | 7.46 | 1520 | 406 | 258 | 44 | 342 | 4.63 | 395 | 32.5 | 191 | 2.9 | 6/10/98 | 4684.3 |
| PZ-2 | 12/17/91 | 24152 | 25526 | 7.46 | 1774 | 470 | 261 | 3.82 | 364 | 10.9 | 102 | 21.4 | | 1.87 | 6/10/98 | 4699.5 |
| PZ-5 | 11/4/97 | 23491 | 26528 | 7.46 | 3250 | 1460 | 878 | 9.44 | 715 | 7 | 333 | 76.4 | 149 | 0.5 | 6/10/98 | 4727.7 |

Sources: Marigold 1997 Annual Report
JBR Baseline Report, 1998
Guyton 1977a

# Table B-6
## Groundwater Quality
## Marigold Mine Area

| WELL NAME | Sample Date | LOCATION Northing | Easting | Fe | Pb | Mn | Alk | As | Ba | Cd | Cr | Cu | Hg | Se | Ag | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **VALMY POWER PLANT WELLS** | | | | | | | | | | | | | | | | |
| | | (T-R-S-qtr/qtr) | | | | | | | | | | | | | | |
| **Test Hole #2** (265-286 feet) | 10/3/75 | (35-44-17ad) | | 0.56 | | | 185.7 | | | | | | | | | |
| **Test Hole #2** (481-491 feet) | 9/19/75 | (35-44-17ad) | | 0.75 | | | 741 | | | | | | | | | |
| **Test Hole #2** (601-622 feet) | 10/1/75 | (35-44-17ad) | | 0.14 | | | 741 | | | | | | | | | |
| **Test Hole #3** (144-196 feet) | 10/30/75 | (34-45-25cc) | | 0.25 | | | 125.4 | | | | | | | | | |
| **Test Hole #3** (410-430 feet) | 10/29/75 | (34-45-25cc) | | 0.14 | | | 141.9 | | | | | | | | | |
| **Test Hole #3** (560-600 feet) | 10/24/75 | (34-45-25cc) | | 0.93 | | | 1122 | | | | | | | | | |
| **Test Hole #4** (410-450 feet) | 11/15/75 | (33-44-9cc) | | 0.51 | | | 116.6 | | | | | | | | | |
| **Test Hole #7** (248-311 feet) | 12/17/75 | (34-43-17aa) | | 0.31 | | | 1136 | | | | | | | | | |
| **Test Hole #8** (442-483 feet) | 1/6/76 | (33-44-27dc) | | 0.05 | | | 125.9 | | | | | | | | | |
| **Test Hole #9** (352-392 feet) | 1/28/76 | (33-43-1cc) | | <3 | | | 208 | | | | | | | | | |
| **MARIGOLD BEDROCK WATER WELLS** | | | | | | | | | | | | | | | | |
| **WW-1** | 12/18/96 | 35934 | 25963 | 0.33 | <.001 | <.002 | 140 | 0.007 | 0.054 | <.002 | <.005 | <.003 | <.0002 | <.003 | <.003 | 0.008 |
| | 12/18/91 | | | 0.007 | <.025 | <.025 | 148 | 0.68 | 0.053 | <.005 | <.025 | 0.002 | <.001 | <.005 | <.025 | 0.004 |
| **WW-2** | 12/18/96 | 30669 | 24836 | 0.37 | 0.002 | 0.007 | 142 | 0.006 | 0.053 | <.002 | <.005 | 0.007 | <.0002 | <.003 | <.003 | 0.007 |
| | 12/27/91 | | | 0.352 | 0.057 | <.025 | 144 | 0.035 | 0.59 | <.005 | <.025 | <.005 | <.001 | <.005 | <.025 | <.25 |
| **WW-3** | 12/18/96 | 25645 | 23880 | 1.28 | 0.007 | 0.006 | 145 | 0.003 | 0.101 | <.002 | <.005 | 0.004 | <.0002 | <.003 | <.003 | 0.003 |
| | 12/27/91 | | | 0.357 | <.025 | 0.002 | 141 | 0.07 | 0.059 | <.005 | <.025 | <.005 | <.001 | <.005 | <.025 | 0.002 |
| **NM-028** | 5/27/86 | 23601 | 19799 | 0.01 | <.2 | 0.01 | 120 | 15 | 100 | <.4 | 0.7 | 4.3 | | <3 | <.1 | 5 |
| **NM-030** | 5/30/86 | 24386 | 19200 | <.01 | <.2 | 0.01 | 140 | 6 | 43 | <.4 | 0.8 | 0.8 | | <3 | <.1 | 2 |

Sources: Marigold 1997 Annual Report
JBR Baseline Report, 1998
Guyton 1977a

# Table B-6
## Groundwater Quality
## Marigold Mine Area

| WELL NAME | Sample Date | LOCATION | | Fe | Pb | Mn | Alk | As | Ba | Cd | Cr | Cu | Hg | Se | Ag | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Northing | Easting | | | | | | | | | | | | | |
| **MARIGOLD ALLUVIAL MONITOR WELLS** | | | | | | | | | | | | | | | | |
| TDOH-6 | 3/8/95 | 24123 | 26072 | 20.5 | 0.029 | 0.496 | 73 | 0.012 | 0.371 | 0.002 | 0.036 | 0.039 | 0.002 | 0.001 | 0.004 | 0.077 |
| TDOH-12L | 11/4/97 | 24522 | 25935 | 0.022 | 0.001 | 0.01 | 73.7 | 0.002 | 0.32 | 0.002 | 0.008 | 0.016 | 0.0002 | 0.002 | 0.005 | 0.061 |
| TDOH-12U | 11/19/96 | 24502 | 25901 | 0.024 | 0.001 | 0.006 | 22.7 | 0.001 | 0.52 | 0.002 | 0.005 | 0.003 | 0.0002 | 0.003 | 0.003 | 0.003 |
| TDOH-15 | 3/9/95 | 24479 | 26130 | 5.88 | 0.006 | 0.117 | 71.4 | 0.005 | 0.29 | 0.002 | 0.026 | 0.014 | 0.0002 | 0.001 | 0.002 | 0.027 |
| TDOH-16 | 11/19/96 | 24319 | 26368 | 0.024 | 0.001 | 0.05 | 157 | 0.002 | 0.05 | 0.002 | 0.005 | 0.003 | 0.0002 | 0.003 | 0.003 | 0.002 |
| TDOH-17 | 10/9/96 | 23912 | 26511 | 0.064 | 0.001 | 0.019 | 157 | 0.002 | 0.057 | 0.002 | 0.005 | 0.02 | 0.0002 | 0.005 | 0.004 | 0.043 |
| TDOH-18L | 11/4/97 | 24098 | 26443 | 0.02 | 0.001 | 0.008 | 155 | 0.002 | 0.058 | 0.002 | 0.008 | 0.031 | 0.0002 | 0.002 | 0.005 | 0.026 |
| TDOH-18U | 11/4/97 | 24098 | 26443 | 0.019 | 0.001 | 0.005 | 192 | 0.018 | 0.043 | 0.002 | 0.008 | 0.004 | 0.0002 | 0.002 | 0.005 | 0.004 |
| TDOH-19L | 11/4/97 | 24484 | 26104 | 0.019 | 0.001 | 0.006 | 166 | 0.003 | 0.038 | 0.002 | 0.008 | 0.005 | 0.0002 | 0.002 | 0.005 | 0.007 |
| TDOH-19U | 11/4/97 | 24484 | 26104 | 0.021 | 0.001 | 0.105 | 160 | 0.023 | 0.06 | 0.002 | 0.008 | 0.004 | 0.0002 | 0.002 | 0.005 | 0.004 |
| TDOH-20L | 11/4/97 | 24383 | 25083 | 0.019 | 0.001 | 0.013 | 124 | 0.006 | 0.058 | 0.002 | 0.008 | 0.006 | 0.0002 | 0.002 | 0.005 | 0.004 |
| TDOH-20U | 11/4/97 | 24383 | 25083 | 0.05 | 0.001 | 0.053 | 253 | 0.04 | 0.041 | 0.002 | 0.008 | 0.006 | 0.0002 | 0.002 | 0.005 | 0.004 |
| **MARIGOLD PERCHED AQUIFER MONITOR WELLS** | | | | | | | | | | | | | | | | |
| TDMP-1 | 11/4/97 | 24221 | 25945 | 0.037 | 0.001 | 0.006 | 22 | 0.001 | 0.311 | 0.002 | 0.008 | 0.004 | 0.002 | 0.002 | 0.005 | 0.004 |
| TDMP-2 | 11/4/97 | 23956 | 26280 | 0.091 | 0.001 | 0.015 | 11.3 | 0.001 | 1.07 | 0.002 | 0.008 | 0.004 | 0.0003 | 0.002 | 0.005 | 0.009 |
| TDOH-1 | 11/4/97 | 24282 | 25866 | 0.286 | 0.001 | 0.026 | 28.9 | 0.001 | 0.394 | 0.002 | 0.008 | 0.004 | 0.003 | 0.004 | 0.005 | 0.004 |
| TDOH-2 | 11/4/97 | 24159 | 26024 | 0.039 | 0.001 | 0.006 | 14.1 | 0.001 | 0.734 | 0.002 | 0.008 | 0.004 | 0.0004 | 0.002 | 0.005 | 0.005 |
| TDOH-3 | 11/4/97 | 24310 | 26022 | 0.019 | 0.001 | 0.001 | 30.3 | 0.002 | 0.611 | 0.002 | 0.008 | 0.004 | 0.0002 | 0.002 | 0.005 | 0.007 |
| TDOH-4 | 11/4/97 | 24407 | 25711 | 0.114 | 0.001 | 0.008 | 21.4 | 0.001 | 0.783 | 0.002 | 0.008 | 0.007 | 0.0006 | 0.002 | 0.005 | 0.009 |
| TDOH-5 | 11/4/97 | 24246 | 26099 | 0.019 | 0.001 | 0.004 | 16.4 | 0.001 | 0.298 | 0.002 | 0.008 | 0.004 | 0.0002 | 0.002 | 0.005 | 0.006 |
| TDOH-7 | 5/6/93 | 24141 | 25590 | 6.5 | 0.085 | 4.76 | 211 | 0.007 | 0.15 | 0.05 | 0.05 | 0.1 | 0.001 | 0.004 | 0.01 | 1.54 |
| TDOH-8 | 8/7/97 | 23303 | 27087 | 0.023 | 0.001 | 0.053 | 39.9 | 0.001 | 0.306 | 0.002 | 0.008 | 0.006 | 0.0002 | 0.003 | 0.005 | 0.024 |
| **TAILINGS DAM** | | | | | | | | | | | | | | | | |
| PZ-1 | 3/6/97 | 24167 | 25551 | 0.267 | 0.001 | 0.114 | 191 | 0.006 | 0.071 | 0.002 | 0.005 | 0.02 | 0.0002 | 0.003 | 0.003 | |
| PZ-2 | 12/17/91 | 24152 | 25526 | 1.38 | 0.06 | 0.406 | 228 | 0.482 | 0.04 | 0.005 | 0.025 | 0.5 | 0.001 | 0.089 | 0.025 | |
| PZ-5 | 11/4/97 | 23491 | 26528 | 0.787 | 0.001 | 0.066 | 139 | 0.003 | 0.021 | 0.002 | 0.008 | 0.02 | 0.004 | 0.002 | 0.005 | |

Note: pH is measured in standard units; all other constituents are measured in mg/l.

Sources: Marigold 1997 Annual Report
JBR Baseline Report, 1998
Guyton 1977a

# Table B-7
## Column Leach Test Results

Profile I analysis

**Edna Mtn.**

| PARAMETER | UNITS | Influent Water W-1 | Week 1 Day 7 | Week 2 Day 14 | Week 3 Day 22 | Week 4 Day 29 | MCL |
|---|---|---|---|---|---|---|---|
| ALKALINITY, TOTAL | mg/L | 136 | 100 | 106 | 109 | 106 | — |
| BICARBONATE | mg/L | 136 | 100 | ND | 109 | 106 | — |
| CARBONATE | mg/L | ND | ND | ND | ND | ND | — |
| HYDROXIDE | mg/L | ND | ND | — | ND | ND | — |
| ALUMINUM | mg/L | 0.078 | < 0.020 | — | 0.042 | — | 0.05 |
| ANTIMONY | mg/L | < 0.003 | < 0.003 | — | 0.004 | — | 0.006 |
| ARSENIC | mg/L | 0.012 | 0.027 | 0.032 | 0.027 | 0.044 | 0.05 |
| BARIUM | mg/L | 0.069 | 0.180 | — | 0.136 | — | 2 |
| BERYLLIUM | mg/L | < 0.002 | < 0.002 | — | < 0.002 | — | 0.004 |
| BORON | mg/L | < 0.10 | < 0.10 | — | 0.12 | — | — |
| CADMIUM | mg/L | < 0.002 | < 0.002 | — | < 0.002 | — | 0.004 |
| CALCIUM | mg/L | 49.6 | 40.4 | 40.0 | 40.7 | 41.3 | — |
| CHLORIDE | mg/L | 21.4 | 20.9 | 23.1 | 23.5 | 26.9 | 250 |
| CHROMIUM | mg/L | < 0.005 | < 0.005 | — | < 0.005 | — | 0.1 |
| CONDUCTIVITY | uS/cm | 455 | 352 | 362 | 365 | 378 | — |
| COPPER | mg/L | < 0.010 | < 0.010 | — | < 0.010 | — | 1.3 |
| FLUORIDE | mg/L | 0.2 | 0.2 | 0.3 | 0.2 | 0.3 | 2 |
| IRON | mg/L | 0.029 | < 0.020 | — | 0.025 | — | 0.3 |
| LEAD | mg/L | 0.007 | < 0.007 | — | 0.008 | — | 0.15 |
| MAGNESIUM | mg/L | 16.2 | 9.85 | 9.76 | 10.2 | 10.0 | 125 |
| MANGANESE | mg/L | 0.018 | < 0.005 | — | < 0.005 | — | 0.05 |
| MERCURY | mg/L | < 0.0005 | < 0.0005 | 0.0010 | < 0.0005 | < 0.0005 | 0.002 |
| MOLYBDENUM | mg/L | < 0.020 | < 0.020 | < 0.020 | < 0.020 | < 0.020 | — |
| NICKEL | mg/L | < 0.020 | < 0.020 | — | < 0.020 | — | 0.01 |
| NITRATE as NITROGEN | mg/L | 0.1 | < 0.1 | < 0.1 | 0.1 | < 0.1 | 10 |
| NITRITE as NITROGEN | mg/L | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 1 |
| NITRATE + NITRITE -N | mg/L | 0.1 | < 0.1 | < 0.1 | 0.1 | < 0.1 | 10 |
| pH | mg/L | 7.85 | 7.96 | 7.88 | 7.75 | 7.99 | 6.5 - 8.5 |
| POTASSIUM | mg/L | 2.4 | 2.54 | 2.85 | 2.44 | 3.73 | — |
| SELENIUM | mg/L | < 0.010 | < 0.010 | — | < 0.010 | — | 0.05 |
| SILVER | mg/L | < 0.010 | < 0.010 | — | < 0.010 | — | 0.1 |
| SODIUM | mg/L | 22.5 | 15.6 | 16.4 | 16.8 | 17.8 | — |
| SULFATE | mg/L | 51.4 | 38.4 | 39.8 | 42.4 | 45.8 | 250 |
| THALLIUM | mg/L | < 0.001 | 0.002 | — | < 0.001 | — | 0.002 |
| TDS | mg/L | 261 | 222 | 222 | 212 | 204 | 500 |
| WAD CYANIDE | mg/L | < 0.025 | < 0.025 | < 0.025 | < 0.025 | < 0.025 | 0.2 |
| ZINC | mg/L | < 0.050 | < 0.050 | — | < 0.050 | — | 5 |

| | | | | | |
|---|---|---|---|---|---|
| CATIONS | 4.49 | 3.57 | 3.61 | 3.69 | 3.79 |
| ANIONS | 3.97 | 3.69 | 3.20 | 3.31 | 3.43 |
| % DIFFERENCE | 6.15 | 3.19 | 6.02 | 5.39 | 4.97 |

## Table B-7 (Continued)

Profile I analysis

**Edna Mtn.**

| PARAMETER | UNITS | Week 5 Day 36 | Week 6 Day 43 | Week 7 Day 50 | Influent Water W-3 Day 51 | Week 8 Day 57 | MCL |
|---|---|---|---|---|---|---|---|
| ALKALINITY, TOTAL | mg/L | 104 | 104 | 99.4 | 153 | 95 | --- |
| BICARBONATE | mg/L | 104 | 104 | 99.4 | 153 | 95 | --- |
| CARBONATE | mg/L | ND | ND | ND | ND | ND | --- |
| HYDROXIDE | mg/L | ND | ND | ND | ND | ND | --- |
| ALUMINUM | mg/L | 0.159 | ---- | 0.020 | 0.036 | ---- | 0.05 |
| ANTIMONY | mg/L | < 0.003 | ---- | < 0.003 | < 0.003 | ---- | 0.006 |
| ARSENIC | mg/L | 0.037 | 0.034 | 0.034 | 0.006 | 0.029 | 0.05 |
| BARIUM | mg/L | 0.183 | ---- | 0.113 | 0.057 | ---- | 2 |
| BERYLLIUM | mg/L | < 0.002 | ---- | < 0.002 | < 0.002 | ---- | 0.004 |
| BORON | mg/L | 0.14 | ---- | 0.15 | < 0.1 | ---- | --- |
| CADMIUM | mg/L | < 0.002 | ---- | < 0.002 | < 0.002 | ---- | 0.004 |
| CALCIUM | mg/L | 39.7 | 39.6 | 40.1 | 46.4 | 36.9 | --- |
| CHLORIDE | mg/L | 27.0 | 30.6 | 30.5 | 24.7 | 32.7 | 250 |
| CHROMIUM | mg/L | < 0.005 | ---- | < 0.005 | < 0.005 | ---- | 0.1 |
| CONDUCTIVITY | uS/cm | 374 | 392 | 391 | 431 | 419 | --- |
| COPPER | mg/L | < 0.010 | ---- | < 0.010 | 0.026 | ---- | 1.3 |
| FLUORIDE | mg/L | 0.2 | 0.3 | 0.2 | 0.2 | 0.2 | 2 |
| IRON | mg/L | 0.188 | ---- | < 0.020 | 0.028 | ---- | 0.3 |
| LEAD | mg/L | 0.038 | ---- | < 0.007 | < 0.007 | ---- | 0.15 |
| MAGNESIUM | mg/L | 10.1 | 10.2 | 9.91 | 14.7 | 9.19 | 125 |
| MANGANESE | mg/L | 0.019 | ---- | < 0.005 | 0.009 | ---- | 0.05 |
| MERCURY | mg/L | < 0.0005 | < 0.0005 | < 0.0005 | < 0.0005 | < 0.0005 | 0.002 |
| MOLYBDENUM | mg/L | < 0.020 | < 0.020 | < 0.020 | < 0.02 | < 0.020 | --- |
| NICKEL | mg/L | < 0.020 | ---- | < 0.020 | < 0.020 | ---- | 0.01 |
| NITRATE as NITROGEN | mg/L | 0.1 | 0.4 | 0.4 | 0.4 | 0.2 | 10 |
| NITRITE as NITROGEN | mg/L | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 1 |
| NITRATE + NITRITE -N | mg/L | 0.1 | 0.4 | 0.4 | 0.4 | 0.2 | 10 |
| pH | mg/L | 8.05 | 8.10 | 8.19 | 7.60 | 8.19 | 6.5 - 8.5 |
| POTASSIUM | mg/L | 2.85 | 2.69 | 2.71 | 1.82 | 2.56 | --- |
| SELENIUM | mg/L | < 0.010 | ---- | < 0.010 | < 0.010 | ---- | 0.05 |
| SILVER | mg/L | < 0.010 | ---- | < 0.010 | < 0.010 | ---- | 0.1 |
| SODIUM | mg/L | 19.4 | 20.1 | 20.2 | 20.9 | 18.8 | --- |
| SULFATE | mg/L | 50.2 | 55.5 | 51.3 | 53.0 | 59.9 | 250 |
| THALLIUM | mg/L | < 0.001 | ---- | < 0.001 | < 0.001 | ---- | 0.002 |
| TDS | mg/L | 215 | 253 | 236 | 234 | 231 | 500 |
| WAD CYANIDE | mg/L | < 0.025 | < 0.025 | < 0.025 | < 0.025 | < 0.025 | 0.2 |
| ZINC | mg/L | < 0.050 | ---- | < 0.050 | < 0.050 | ---- | 5 |

| | | | | | |
|---|---|---|---|---|---|
| CATIONS | 3.76 | 3.78 | 3.31 | 4.51 | 3.5 |
| ANIONS | 3.49 | 3.73 | 3.55 | 4.29 | 3.72 |
| % DIFFERENCE | 3.75 | 0.71 | 3.56 | 2.48 | 2.96 |

## Table B-7 (Continued)

Profile I analysis

**Edna Mtn.**

| PARAMETER | UNITS | Week 9 Day 64 | Week 10 Day 71 | Week 11 Day78 | Week 12 Day 85 | MCL |
|---|---|---|---|---|---|---|
| ALKALINITY, TOTAL | mg/L | 89 | 78 | 74 | 77 | --- |
| BICARBONATE | mg/L | 89 | 78 | 74 | 77 | --- |
| CARBONATE | mg/L | ND | ND | ND | ND | --- |
| HYDROXIDE | mg/L | ND | ND | ND | ND | --- |
| ALUMINUM | mg/L | 0.041 | ---- | 0.036 | ---- | 0.05 |
| ANTIMONY | mg/L | < 0.003 | ---- | < 0.003 | ---- | 0.006 |
| ARSENIC | mg/L | 0.031 | 0.033 | 0.031 | 0.032 | 0.05 |
| BARIUM | mg/L | 0.123 | ---- | 0.096 | ---- | 2 |
| BERYLLIUM | mg/L | < 0.002 | ---- | < 0.002 | ---- | 0.004 |
| BORON | mg/L | < 0.10 | ---- | 0.15 | ---- | --- |
| CADMIUM | mg/L | < 0.002 | ---- | < 0.002 | ---- | 0.004 |
| CALCIUM | mg/L | 37.2 | 36.9 | 35.4 | 37.0 | --- |
| CHLORIDE | mg/L | 30.8 | 28.2 | 37.6 | 32.4 | 250 |
| CHROMIUM | mg/L | < 0.005 | ---- | < 0.005 | ---- | 0.1 |
| CONDUCTIVITY | uS/cm | 381 | 379 | 387 | 408 | --- |
| COPPER | mg/L | < 0.010 | ---- | < 0.010 | ---- | 1.3 |
| FLUORIDE | mg/L | 0.2 | 0.1 | 0.3 | 0.3 | 2 |
| IRON | mg/L | 0.025 | ---- | 0.037 | ---- | 0.3 |
| LEAD | mg/L | 0.015 | ---- | < 0.007 | ---- | 0.15 |
| MAGNESIUM | mg/L | 9.57 | 9.18 | 9.34 | 10.1 | 125 |
| MANGANESE | mg/L | < 0.005 | ---- | < 0.005 | ---- | 0.05 |
| MERCURY | mg/L | < 0.0005 | < 0.0005 | < 0.0005 | < 0.0005 | 0.002 |
| MOLYBDENUM | mg/L | 0.021 | 0.024 | 0.025 | 0.021 | --- |
| NICKEL | mg/L | < 0.020 | ---- | < 0.020 | ---- | 0.01 |
| NITRATE as NITROGEN | mg/L | 0.2 | < 0.1 | < 0.1 | 0.1 | 10 |
| NITRITE as NITROGEN | mg/L | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 1 |
| NITRATE + NITRITE -N | mg/L | 0.2 | < 0.1 | < 0.1 | 0.1 | 10 |
| pH | mg/L | 8.04 | 8.34 | 8.20 | 8.27 | 6.5 - 8.5 |
| POTASSIUM | mg/L | 2.43 | 2.41 | 2.37 | 1.97 | --- |
| SELENIUM | mg/L | < 0.010 | ---- | < 0.010 | ---- | 0.05 |
| SILVER | mg/L | < 0.010 | ---- | < 0.010 | ---- | 0.1 |
| SODIUM | mg/L | 19.8 | 20.4 | 21.9 | 20.0 | --- |
| SULFATE | mg/L | 62.3 | 51.4 | 70.5 | 61.9 | 250 |
| THALLIUM | mg/L | < 0.001 | ---- | < 0.001 | ---- | 0.002 |
| TDS | mg/L | 239 | 225 | 214 | 246 | 500 |
| WAD CYANIDE | mg/L | < 0.025 | < 0.025 | < 0.025 | < 0.025 | 0.2 |
| ZINC | mg/L | < 0.050 | ---- | < 0.050 | ---- | 5 |

| | | | | |
|---|---|---|---|---|
| CATIONS | 3.59 | 3.57 | 3.57 | 3.63 |
| ANIONS | 3.62 | 3.13 | 3.72 | 3.46 |
| % DIFFERENCE | 0.38 | 6.59 | 2.57 | 2.38 |

## Table B-7 (Continued)

Profile I analysis

**Edna Mtn.**

| PARAMETER | UNITS | Week 13 Day92 | Week 14 Day99 | Week 15 Day106 | Week 16 Day113 | MCL |
|---|---|---|---|---|---|---|
| ALKALINITY, TOTAL | mg/L | 82 | 87 | 87 | 86 | --- |
| BICARBONATE | mg/L | 82 | 87 | 87 | 86 | --- |
| CARBONATE | mg/L | ND | ND | ND | ND | --- |
| HYDROXIDE | mg/L | ND | ND | ND | ND | --- |
| ALUMINUM | mg/L | 0.030 | ---- | 0.020 | ---- | 0.05 |
| ANTIMONY | mg/L | 0.004 | ---- | < 0.003 | ---- | 0.006 |
| ARSENIC | mg/L | 0.037 | 0.035 | 0.031 | 0.032 | 0.05 |
| BARIUM | mg/L | 0.082 | ---- | 0.064 | ---- | 2 |
| BERYLLIUM | mg/L | < 0.002 | ---- | < 0.002 | ---- | 0.004 |
| BORON | mg/L | 0.10 | ---- | 0.10 | ---- | --- |
| CADMIUM | mg/L | < 0.002 | ---- | < 0.002 | ---- | 0.004 |
| CALCIUM | mg/L | 37.9 | 41.7 | 36.6 | 37.7 | --- |
| CHLORIDE | mg/L | 30.9 | 35.2 | 38.4 | 38.3 | 250 |
| CHROMIUM | mg/L | < 0.005 | ---- | < 0.005 | ---- | 0.1 |
| CONDUCTIVITY | uS/cm | 356 | 440 | 373 | 390 | --- |
| COPPER | mg/L | < 0.010 | ---- | < 0.010 | ---- | 1.3 |
| FLUORIDE | mg/L | 0.2 | 0.3 | 0.1 | 0.4 | 2 |
| IRON | mg/L | 0.021 | ---- | 0.024 | ---- | 0.3 |
| LEAD | mg/L | < 0.007 | ---- | 0.008 | ---- | 0.15 |
| MAGNESIUM | mg/L | 9.22 | 9.65 | 9.56 | 9.63 | 125 |
| MANGANESE | mg/L | < 0.005 | ---- | < 0.005 | ---- | 0.05 |
| MERCURY | mg/L | < 0.0005 | < 0.0005 | < 0.0005 | < 0.0005 | 0.002 |
| MOLYBDENUM | mg/L | 0.024 | < 0.020 | 0.021 | 0.021 | --- |
| NICKEL | mg/L | < 0.020 | ---- | < 0.020 | ---- | 0.01 |
| NITRATE as NITROGEN | mg/L | 0.1 | 0.2 | 0.2 | 0.3 | 10 |
| NITRITE as NITROGEN | mg/L | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 1 |
| NITRATE + NITRITE -N | mg/L | 0.1 | 0.2 | 0.2 | 0.3 | 10 |
| pH | mg/L | 8.14 | 8.26 | 8.12 | 8.06 | 6.5 - 8.5 |
| POTASSIUM | mg/L | 2.61 | 3.37 | 2.73 | 2.75 | --- |
| SELENIUM | mg/L | < 0.010 | ---- | < 0.010 | ---- | 0.05 |
| SILVER | mg/L | < 0.010 | ---- | < 0.010 | ---- | 0.1 |
| SODIUM | mg/L | 24.3 | 25.7 | 22.4 | 22.7 | --- |
| SULFATE | mg/L | 56.3 | 69.6 | 71.6 | 78.0 | 250 |
| THALLIUM | mg/L | < 0.001 | ---- | < 0.001 | ---- | 0.002 |
| TDS | mg/L | 202 | 234 | 233 | 270 | 500 |
| WAD CYANIDE | mg/L | < 0.025 | < 0.025 | < 0.025 | < 0.025 | 0.2 |
| ZINC | mg/L | < 0.050 | ---- | < 0.050 | ---- | 5 |

| | | | | |
|---|---|---|---|---|
| CATIONS | 3.80 | 4.11 | 3.68 | 3.76 |
| ANIONS | 3.88 | 3.87 | 3.99 | 4.13 |
| % DIFFERENCE | 5.86 | 3.03 | 4.00 | 4.69 |

## Table B-7 (Continued)

Profile I analysis

**Edna Mtn.**

| PARAMETER | UNITS | Influent Water W-6 Day 116 | Week 17 Day120 | Week 18 Day127 | Week 19 Day 134 | Week 20 Day141 | MCL |
|---|---|---|---|---|---|---|---|
| ALKALINITY, TOTAL | mg/L | 139 | 89 | 91 | 86 | 92 | — |
| BICARBONATE | mg/L | 139 | 89 | 91 | 86 | 92 | — |
| CARBONATE | mg/L | ND | ND | ND | ND | ND | — |
| HYDROXIDE | mg/L | ND | ND | ND | ND | ND | — |
| ALUMINUM | mg/L | 0.027 | < 0.020 | — | < 0.020 | 0.020 | 0.05 |
| ANTIMONY | mg/L | < 0.003 | 0.003 | — | < 0.003 | < 0.003 | 0.006 |
| ARSENIC | mg/L | 0.006 | 0.029 | 0.031 | 0.035 | 0.028 | 0.05 |
| BARIUM | mg/L | 0.062 | 0.063 | — | 0.063 | 0.060 | 2 |
| BERYLLIUM | mg/L | < 0.002 | < 0.002 | — | < 0.002 | < 0.002 | 0.004 |
| BORON | mg/L | 0.10 | 0.10 | — | < 0.10 | 0.11 | — |
| CADMIUM | mg/L | < 0.002 | < 0.002 | — | < 0.002 | < 0.002 | 0.004 |
| CALCIUM | mg/L | 51.1 | 39.1 | 38.2 | 38.7 | 37.3 | — |
| CHLORIDE | mg/L | 30.5 | 35.1 | 35.4 | 29.3 | 33.5 | 250 |
| CHROMIUM | mg/L | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | 0.1 |
| CONDUCTIVITY | uS/cm | 443 | 352 | 376 | 294 | 330 | — |
| COPPER | mg/L | < 0.010 | < 0.010 | — | < 0.010 | < 0.010 | 1.3 |
| FLUORIDE | mg/L | 0.4 | 0.4 | 0.4 | 0.3 | 0.3 | 2 |
| IRON | mg/L | 0.029 | < 0.020 | — | < 0.020 | 0.034 | 0.3 |
| LEAD | mg/L | < 0.007 | < 0.007 | — | < 0.007 | < 0.007 | 0.15 |
| MAGNESIUM | mg/L | 15.7 | 9.39 | 9.66 | 9.68 | 9.55 | 125 |
| MANGANESE | mg/L | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | 0.05 |
| MERCURY | mg/L | < 0.0005 | < 0.0005 | < 0.0005 | < 0.0005 | < 0.0005 | 0.002 |
| MOLYBDENUM | mg/L | < 0.020 | 0.024 | < 0.020 | < 0.020 | < 0.020 | — |
| NICKEL | mg/L | < 0.020 | < 0.020 | — | < 0.020 | < 0.020 | 0.01 |
| NITRATE as NITROGEN | mg/L | 0.2 | 0.3 | 0.2 | 0.3 | 0.3 | 10 |
| NITRITE as NITROGEN | mg/L | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 1 |
| NITRATE + NITRITE -N | mg/L | 0.2 | 0.3 | 0.2 | 0.3 | 0.3 | 10 |
| pH | mg/L | 7.78 | 8.07 | 8.08 | 8.18 | 8.02 | 6.5 - 8.5 |
| POTASSIUM | mg/L | 2.79 | 2.47 | 2.58 | 2.35 | 1.94 | — |
| SELENIUM | mg/L | < 0.010 | < 0.010 | — | < 0.010 | < 0.010 | 0.05 |
| SILVER | mg/L | < 0.010 | < 0.010 | — | < 0.010 | < 0.010 | 0.1 |
| SODIUM | mg/L | 23.4 | 21.0 | 20.9 | 20.8 | 20.2 | — |
| SULFATE | mg/L | 60.0 | 76.0 | 70.7 | 71.0 | 69.7 | 250 |
| THALLIUM | mg/L | < 0.001 | < 0.001 | — | < 0.001 | < 0.001 | 0.002 |
| TDS | mg/L | 287 | 242 | 229 | 231 | 238 | 500 |
| WAD CYANIDE | mg/L | < 0.025 | < 0.025 | < 0.025 | < 0.025 | < 0.025 | 0.2 |
| ZINC | mg/L | < 0.050 | < 0.050 | — | < 0.050 | < 0.050 | 5 |

| | | | | | |
|---|---|---|---|---|---|
| CATIONS | 4.96 | 3.73 | 3.70 | 3.72 | 3.61 |
| ANIONS | 4.37 | 4.05 | 3.97 | 3.72 | 3.90 |
| % DIFFERENCE | 6.92 | 4.11 | 3.45 | 0.09 | 4.13 |

## Table B-7 (Continued)

**Havallah**

| PARAMETER | UNITS | Influent Water W-2 | Week 1 Day 7 | Week 2 Day 14 | Week 3 Day 22 | Week 4 Day 29 | MCL |
|---|---|---|---|---|---|---|---|
| ALKALINITY, TOTAL | mg/L | 131 | 150 | 170 | 158 | 146 | — |
| BICARBONATE | mg/L | 131 | 150 | ND | 158 | 146 | — |
| CARBONATE | mg/L | ND | ND | ND | ND | ND | — |
| HYDROXIDE | mg/L | ND | ND | — | ND | ND | — |
| ALUMINUM | mg/L | 0.039 | 0.046 | — | 0.086 | — | 0.05 |
| ANTIMONY | mg/L | < 0.003 | 0.006 | — | < 0.003 | — | 0.006 |
| ARSENIC | mg/L | 0.007 | 0.007 | 0.011 | 0.008 | 0.012 | 0.05 |
| BARIUM | mg/L | 0.073 | 0.151 | — | 0.189 | — | 2 |
| BERYLLIUM | mg/L | < 0.002 | < 0.002 | — | < 0.002 | — | 0.004 |
| BORON | mg/L | < 0.10 | 0.11 | — | 0.190 | — | — |
| CADMIUM | mg/L | < 0.002 | < 0.002 | — | < 0.002 | — | 0.004 |
| CALCIUM | mg/L | 65.4 | 45.0 | 45.5 | 45.5 | 42.2 | — |
| CHLORIDE | mg/L | 21.6 | 28.4 | 31.8 | 27.8 | 30.4 | 250 |
| CHROMIUM | mg/L | < 0.005 | < 0.005 | — | < 0.005 | — | 0.1 |
| CONDUCTIVITY | uS/cm | 418 | 555 | 564 | 548 | 526 | — |
| COPPER | mg/L | < 0.010 | < 0.010 | — | < 0.010 | — | 1.3 |
| FLUORIDE | mg/L | 0.2 | 0.6 | 0.6 | 0.6 | 0.6 | 2 |
| IRON | mg/L | 0.042 | 0.031 | — | 0.041 | — | 0.3 |
| LEAD | mg/L | 0.017 | < 0.007 | — | < 0.007 | — | 0.15 |
| MAGNESIUM | mg/L | 16.2 | 8.52 | 8.71 | 8.66 | 8.11 | 125 |
| MANGANESE | mg/L | < 0.005 | < 0.005 | — | < 0.005 | — | 0.05 |
| MERCURY | mg/L | < 0.0005 | < 0.0005 | < 0.0005 | < 0.0005 | < 0.0005 | 0.002 |
| MOLYBDENUM | mg/L | < 0.020 | < 0.020 | < 0.020 | < 0.020 | < 0.020 | — |
| NICKEL | mg/L | < 0.020 | < 0.020 | — | < 0.020 | — | 0.01 |
| NITRATE as NITROGEN | mg/L | 0.2 | 0.3 | 0.5 | 0.7 | 0.7 | 10 |
| NITRITE as NITROGEN | mg/L | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 1 |
| NITRATE + NITRITE -N | mg/L | 0.2 | 0.3 | 0.5 | 0.7 | 0.7 | 10 |
| pH | mg/L | 7.69 | 8.15 | 8.25 | 8.03 | 8.26 | 6.5 - 8.5 |
| POTASSIUM | mg/L | 2.41 | 4.05 | 4.81 | 4.12 | 4.50 | — |
| SELENIUM | mg/L | < 0.010 | < 0.010 | — | < 0.010 | — | 0.05 |
| SILVER | mg/L | 0.018 | < 0.010 | — | < 0.010 | — | 0.1 |
| SODIUM | mg/L | 22.9 | 56.9 | 59.0 | 51.9 | 55 | — |
| SULFATE | mg/L | 52.1 | 74.6 | 76.4 | 70.3 | 77.0 | 250 |
| THALLIUM | mg/L | < 0.001 | < 0.001 | — | < 0.001 | — | 0.002 |
| TDS | mg/L | 266 | 316 | 350 | 296 | 304 | 500 |
| WAD CYANIDE | mg/L | < 0.025 | < 0.025 | < 0.025 | < 0.025 | < 0.025 | 0.2 |
| ZINC | mg/L | < 0.050 | < 0.050 | — | < 0.050 | — | 5 |
| | | | | | | | |
| CATIONS | | 4.46 | 5.53 | 5.73 | 5.39 | 5.31 | |
| ANIONS | | 3.95 | 5.56 | 5.28 | 4.86 | 4.89 | |
| % DIFFERENCE | | 6.07 | 0.46 | 4.06 | 5.12 | 4.17 | |

## Table B-7 (Continued)

**Havallah**

| PARAMETER | UNITS | Week 5 Day 36 | Week 6 Day 43 | Influent Water W-4 Day 48 | Week 7 Day 50 | Week 8 Day 57 | MCL |
|---|---|---|---|---|---|---|---|
| ALKALINITY, TOTAL | mg/L | 142 | 136 | 155 | 135 | 131 | — |
| BICARBONATE | mg/L | 142 | 136 | 155 | 135 | 131 | — |
| CARBONATE | mg/L | ND | ND | ND | ND | ND | — |
| HYDROXIDE | mg/L | ND | ND | ND | ND | ND | — |
| ALUMINUM | mg/L | 0.205 | — | 0.044 | 0.268 | — | 0.05 |
| ANTIMONY | mg/L | < 0.003 | — | < 0.003 | < 0.003 | — | 0.006 |
| ARSENIC | mg/L | 0.012 | 0.011 | 0.012 | 0.011 | 0.011 | 0.05 |
| BARIUM | mg/L | 0.166 | — | 0.050 | 0.135 | — | 2 |
| BERYLLIUM | mg/L | < 0.002 | — | < 0.002 | < 0.002 | — | 0.004 |
| BORON | mg/L | 0.18 | — | < 0.1 | 0.20 | — | — |
| CADMIUM | mg/L | < 0.002 | — | < 0.002 | < 0.002 | — | 0.004 |
| CALCIUM | mg/L | 41.1 | 40.1 | 48.8 | 39.8 | 38.6 | — |
| CHLORIDE | mg/L | 32.2 | 35.7 | 24.9 | 33.4 | 37.0 | 250 |
| CHROMIUM | mg/L | < 0.005 | — | < 0.005 | < 0.005 | — | 0.1 |
| CONDUCTIVITY | uS/cm | 526 | 521 | 402 | 519 | 547 | — |
| COPPER | mg/L | < 0.010 | — | 0.078 | < 0.010 | — | 1.3 |
| FLUORIDE | mg/L | 0.6 | 0.6 | 0.2 | 0.5 | 0.6 | 2 |
| IRON | mg/L | 0.198 | — | 0.024 | 0.142 | — | 0.3 |
| LEAD | mg/L | 0.008 | — | < 0.007 | < 0.007 | — | 0.15 |
| MAGNESIUM | mg/L | 8.02 | 7.94 | 15.4 | 7.76 | 7.5 | 125 |
| MANGANESE | mg/L | 0.021 | — | 0.026 | < 0.005 | — | 0.05 |
| MERCURY | mg/L | < 0.0005 | < 0.0005 | 0.0027 | < 0.0005 | < 0.0005 | 0.002 |
| MOLYBDENUM | mg/L | < 0.020 | < 0.020 | < 0.020 | < 0.020 | < 0.020 | — |
| NICKEL | mg/L | 0.027 | — | < 0.020 | < 0.020 | — | 0.01 |
| NITRATE as NITROGEN | mg/L | 0.6 | 1.0 | 0.2 | 1.5 | 1.4 | 10 |
| NITRITE as NITROGEN | mg/L | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 1 |
| NITRATE + NITRITE -N | mg/L | 0.6 | 1.0 | 0.2 | 1.5 | 1.4 | 10 |
| pH | mg/L | 8.19 | 8.19 | 7.90 | 8.29 | 8.32 | 6.5 - 8.5 |
| POTASSIUM | mg/L | 4.04 | 4.18 | 1.89 | 4.08 | 3.95 | — |
| SELENIUM | mg/L | < 0.010 | — | < 0.010 | < 0.010 | — | 0.05 |
| SILVER | mg/L | < 0.010 | — | < 0.010 | < 0.010 | — | 0.1 |
| SODIUM | mg/L | 52.1 | 52.6 | 21.8 | 50.3 | 46.6 | — |
| SULFATE | mg/L | 77.7 | 80.2 | 56.7 | 77.0 | 83.2 | 250 |
| THALLIUM | mg/L | < 0.001 | — | < 0.001 | < 0.001 | — | 0.002 |
| TDS | mg/L | 290 | 308 | 247 | 310 | 307 | 500 |
| WAD CYANIDE | mg/L | < 0.025 | < 0.025 | < 0.025 | < 0.025 | < 0.025 | 0.2 |
| ZINC | mg/L | < 0.050 | — | < 0.050 | < 0.050 | — | 5 |
| CATIONS | | 5.13 | 5.09 | 4.73 | 4.96 | 4.72 | |
| ANIONS | | 4.88 | 4.96 | 4.39 | 4.84 | 5.01 | |
| % DIFFERENCE | | 2.52 | 1.28 | 3.73 | 1.21 | 3.03 | |

Table B-7 (Continued)

**Havallah**

| PARAMETER | UNITS | Week 9 Day 64 | Week 10 Day 71 | Week 11 Day78 | Week 12 Day85 | MCL |
|---|---|---|---|---|---|---|
| ALKALINITY, TOTAL | mg/L | 134 | 127 | 114 | 128 | --- |
| BICARBONATE | mg/L | 134 | 127 | 114 | 128 | --- |
| CARBONATE | mg/L | ND | ND | ND | ND | --- |
| HYDROXIDE | mg/L | ND | ND | ND | ND | --- |
| ALUMINUM | mg/L | 0.074 | ---- | 0.090 | ---- | 0.05 |
| ANTIMONY | mg/L | < 0.003 | ---- | < 0.003 | ---- | 0.006 |
| ARSENIC | mg/L | 0.012 | 0.010 | 0.009 | 0.008 | 0.05 |
| BARIUM | mg/L | 0.140 | ---- | 0.136 | ---- | 2 |
| BERYLLIUM | mg/L | < 0.002 | ---- | < 0.002 | ---- | 0.004 |
| BORON | mg/L | < 0.10 | ---- | 0.18 | ---- | --- |
| CADMIUM | mg/L | < 0.002 | ---- | < 0.002 | ---- | 0.004 |
| CALCIUM | mg/L | 41.4 | 42.7 | 43.3 | 37.6 | --- |
| CHLORIDE | mg/L | 35.7 | 30.2 | 38.6 | 32.0 | 250 |
| CHROMIUM | mg/L | < 0.005 | ---- | 0.008 | ---- | 0.1 |
| CONDUCTIVITY | uS/cm | 517 | 509 | 534 | 530 | --- |
| COPPER | mg/L | < 0.010 | ---- | < 0.010 | ---- | 1.3 |
| FLUORIDE | mg/L | 0.4 | 0.4 | 0.7 | 0.5 | 2 |
| IRON | mg/L | 0.038 | ---- | 0.105 | ---- | 0.3 |
| LEAD | mg/L | 0.009 | ---- | < 0.007 | ---- | 0.15 |
| MAGNESIUM | mg/L | 8.21 | 8.22 | 8.69 | 7.89 | 125 |
| MANGANESE | mg/L | < 0.005 | ---- | 0.007 | ---- | 0.05 |
| MERCURY | mg/L | < 0.0005 | < 0.0005 | < 0.0005 | < 0.0005 | 0.002 |
| MOLYBDENUM | mg/L | < 0.020 | < 0.020 | < 0.020 | < 0.020 | --- |
| NICKEL | mg/L | < 0.020 | ---- | < 0.020 | ---- | 0.01 |
| NITRATE as NITROGEN | mg/L | 1.4 | 1.0 | 1.1 | 0.7 | 10 |
| NITRITE as NITROGEN | mg/L | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 1 |
| NITRATE + NITRITE -N | mg/L | 1.4 | 1.0 | 1.1 | 0.7 | 10 |
| pH | mg/L | 8.22 | 8.38 | 8.33 | 8.29 | 6.5 - 8.5 |
| POTASSIUM | mg/L | 3.67 | 3.79 | 3.58 | 3.36 | --- |
| SELENIUM | mg/L | < 0.010 | ---- | < 0.010 | ---- | 0.05 |
| SILVER | mg/L | < 0.010 | ---- | < 0.010 | ---- | 0.1 |
| SODIUM | mg/L | 45.5 | 48.7 | 49.5 | 39.0 | --- |
| SULFATE | mg/L | 83.8 | 70.8 | 89.6 | 73.9 | 250 |
| THALLIUM | mg/L | < 0.001 | ---- | < 0.001 | ---- | 0.002 |
| TDS | mg/L | 314 | 337 | 285 | 320 | 500 |
| WAD CYANIDE | mg/L | < 0.025 | < 0.025 | < 0.025 | < 0.025 | 0.2 |
| ZINC | mg/L | < 0.050 | ---- | < 0.050 | ---- | 5 |

| | | | | |
|---|---|---|---|---|
| CATIONS | 4.85 | 5.06 | 5.17 | 4.34 |
| ANIONS | 5.02 | 4.46 | 4.90 | 4.57 |
| % DIFFERENCE | 1.72 | 6.38 | 2.62 | 2.58 |

## Table B-7 (Continued)

**Havallah**

| PARAMETER | UNITS | | Week 13 Day92 | | Week 14 Day99 | | Week 15 Day106 | Influent Water W-5 Day 109 | | Week 16 Day113 | MCL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ALKALINITY, TOTAL | mg/L | | 128 | | 107 | | 127 | 144 | | 124 | |
| BICARBONATE | mg/L | | 128 | | 107 | | 127 | 144 | | 124 | — |
| CARBONATE | mg/L | | ND | | ND | | ND | ND | | ND | — |
| HYDROXIDE | mg/L | | ND | | ND | | ND | ND | | ND | — |
| ALUMINUM | mg/L | | 0.073 | | — | | 0.044 | 0.045 | | — | 0.05 |
| ANTIMONY | mg/L | < | 0.003 | | — | < | 0.003 | < 0.003 | | — | 0.006 |
| ARSENIC | mg/L | | 0.010 | | 0.007 | | 0.009 | 0.010 | | 0.008 | 0.05 |
| BARIUM | mg/L | | 0.124 | | — | | 0.124 | 0.058 | | — | 2 |
| BERYLLIUM | mg/L | < | 0.002 | | — | < | 0.002 | < 0.002 | | — | 0.004 |
| BORON | mg/L | | 0.16 | | — | | 0.12 | 0.10 | | — | — |
| CADMIUM | mg/L | < | 0.002 | | — | < | 0.002 | < 0.002 | | — | 0.004 |
| CALCIUM | mg/L | | 45.1 | | 47.1 | | 48.1 | 51.8 | | 42.8 | — |
| CHLORIDE | mg/L | | 35.4 | | 38.9 | | 44.0 | 31.4 | | 44.0 | 250 |
| CHROMIUM | mg/L | < | 0.005 | | — | < | 0.005 | < 0.005 | | — | 0.1 |
| CONDUCTIVITY | uS/cm | | 477 | | 594 | | 484 | 433 | | 497 | — |
| COPPER | mg/L | < | 0.010 | | — | < | 0.010 | 0.040 | | — | 1.3 |
| FLUORIDE | mg/L | | 0.5 | | 0.7 | | 0.9 | 0.1 | | 1.0 | 2 |
| IRON | mg/L | | 0.039 | | — | | 0.038 | 0.046 | | — | 0.3 |
| LEAD | mg/L | < | 0.007 | | — | | 0.008 | 0.010 | | — | 0.15 |
| MAGNESIUM | mg/L | | 8.30 | | 9.31 | | 9.36 | 15.4 | | 8.32 | 125 |
| MANGANESE | mg/L | < | 0.005 | | — | < | 0.005 | 0.022 | | — | 0.05 |
| MERCURY | mg/L | < | 0.0005 | < | 0.0005 | < | 0.0005 | 0.0009 | < | 0.0005 | 0.002 |
| MOLYBDENUM | mg/L | < | 0.020 | < | 0.020 | < | 0.020 | < 0.020 | < | 0.020 | — |
| NICKEL | mg/L | < | 0.020 | | — | < | 0.020 | < 0.020 | | — | 0.01 |
| NITRATE as NITROGEN | mg/L | | 1.1 | | 1.0 | | 1.3 | 0.6 | | 1.0 | 10 |
| NITRITE as NITROGEN | mg/L | < | 0.1 | < | 0.1 | < | 0.1 | < 0.1 | < | 0.1 | 1 |
| NITRATE + NITRITE -N | mg/L | | 1.1 | | 1.0 | | 1.3 | 0.6 | | 1.0 | 10 |
| pH | mg/L | | 8.21 | | 7.26 | | 8.20 | 7.77 | | 8.09 | 6.5 - 8.5 |
| POTASSIUM | mg/L | | 4.08 | | 5.10 | | 4.84 | 2.53 | | 4.23 | — |
| SELENIUM | mg/L | < | 0.010 | | — | < | 0.010 | < 0.010 | | — | 0.05 |
| SILVER | mg/L | < | 0.010 | | — | < | 0.010 | < 0.010 | | — | 0.1 |
| SODIUM | mg/L | | 50.5 | | 49.7 | | 48.7 | 23.2 | | 44.0 | — |
| SULFATE | mg/L | | 75.9 | | 118 | | 105 | 69.8 | | 93.7 | 250 |
| THALLIUM | mg/L | < | 0.001 | | — | < | 0.001 | < 0.001 | | — | 0.002 |
| TDS | mg/L | | 340 | | 315 | | 300 | 264 | | 286 | 500 |
| WAD CYANIDE | mg/L | < | 0.025 | < | 0.025 | < | 0.025 | < 0.025 | < | 0.025 | 0.2 |
| ZINC | mg/L | < | 0.050 | | — | < | 0.050 | < 0.050 | | — | 5 |
| CATIONS | | | 5.27 | | 5.45 | | 4.45 | 4.96 | | 4.88 | |
| ANIONS | | | 4.74 | | 5.37 | | 5.61 | 4.70 | | 5.31 | |
| % DIFFERENCE | | | 5.34 | | 0.71 | | 1.39 | 2.74 | | 4.20 | |

## Table B-7 (Continued)

**Havallah**

| PARAMETER | UNITS | Week 17 Day120 | Week 18 Day127 | Week 19 Day 134 | Week 20 Day141 | MCL |
|---|---|---|---|---|---|---|
| ALKALINITY, TOTAL | mg/L | 122 | 124 | 123 | 122 | --- |
| BICARBONATE | mg/L | 122 | 124 | 123 | 122 | --- |
| CARBONATE | mg/L | ND | ND | ND | ND | --- |
| HYDROXIDE | mg/L | ND | ND | ND | ND | --- |
| ALUMINUM | mg/L | < 0.020 | ---- | 0.037 | 0.032 | 0.05 |
| ANTIMONY | mg/L | < 0.003 | ---- | < 0.003 | < 0.003 | 0.006 |
| ARSENIC | mg/L | 0.007 | 0.008 | 0.013 | 0.007 | 0.05 |
| BARIUM | mg/L | 0.108 | ---- | 0.106 | 0.105 | 2 |
| BERYLLIUM | mg/L | < 0.002 | ---- | < 0.002 | < 0.002 | 0.004 |
| BORON | mg/L | 0.12 | ---- | < 0.10 | 0.11 | --- |
| CADMIUM | mg/L | < 0.002 | ---- | < 0.002 | < 0.002 | 0.004 |
| CALCIUM | mg/L | 43.2 | 41.0 | 42.7 | 42.0 | --- |
| CHLORIDE | mg/L | 38.3 | 38.3 | 37.0 | 35.3 | 250 |
| CHROMIUM | mg/L | < 0.005 | ---- | < 0.005 | < 0.005 | 0.1 |
| CONDUCTIVITY | uS/cm | 443 | 461 | 369 | 394 | --- |
| COPPER | mg/L | < 0.010 | ---- | < 0.010 | < 0.010 | 1.3 |
| FLUORIDE | mg/L | 0.7 | 0.8 | 0.7 | 0.7 | 2 |
| IRON | mg/L | 0.028 | ---- | 0.047 | 0.046 | 0.3 |
| LEAD | mg/L | < 0.007 | ---- | 0.011 | < 0.007 | 0.15 |
| MAGNESIUM | mg/L | 7.99 | 7.85 | 8.25 | 8.15 | 125 |
| MANGANESE | mg/L | < 0.005 | ---- | < 0.005 | < 0.005 | 0.05 |
| MERCURY | mg/L | < 0.0005 | < 0.0005 | < 0.0005 | < 0.0005 | 0.002 |
| MOLYBDENUM | mg/L | < 0.020 | < 0.020 | < 0.020 | < 0.020 | --- |
| NICKEL | mg/L | < 0.020 | ---- | < 0.020 | < 0.020 | 0.01 |
| NITRATE as NITROGEN | mg/L | 0.7 | 0.6 | 0.6 | 0.5 | 10 |
| NITRITE as NITROGEN | mg/L | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 1 |
| NITRATE + NITRITE -N | mg/L | 0.7 | 0.6 | 0.6 | 0.5 | 10 |
| pH | mg/L | 8.16 | 8.12 | 8.30 | 7.98 | 6.5 - 8.5 |
| POTASSIUM | mg/L | 3.67 | 3.57 | 3.50 | 2.96 | --- |
| SELENIUM | mg/L | < 0.010 | ---- | < 0.010 | < 0.010 | 0.05 |
| SILVER | mg/L | < 0.010 | ---- | < 0.010 | < 0.010 | 0.1 |
| SODIUM | mg/L | 38.8 | 36.1 | 38.0 | 37.7 | --- |
| SULFATE | mg/L | 89.8 | 88.2 | 79.6 | 68.6 | 250 |
| THALLIUM | mg/L | < 0.001 | ---- | < 0.001 | < 0.001 | 0.002 |
| TDS | mg/L | 292 | 318 | 297 | 287 | 500 |
| WAD CYANIDE | mg/L | < 0.025 | < 0.025 | < 0.025 | < 0.025 | 0.2 |
| ZINC | mg/L | < 0.050 | ---- | < 0.050 | < 0.050 | 5 |

| | | | | |
|---|---|---|---|---|
| CATIONS | 4.63 | 4.39 | 4.59 | 4.52 |
| ANIONS | 5.00 | 4.99 | 4.75 | 4.45 |
| % DIFFERENCE | 3.82 | 6.46 | 1.79 | 0.71 |

# APPENDIX C

## REPRESENTATIVE WILDLIFE SPECIES IN THE VICINITY OF THE MARIGOLD MINE

## Appendix C
## Representative Wildlife Species
## In the Vicinity of the Marigold Mine
## (Including Battle Mountain Range and Humboldt River)

| | |
|---|---|
| **MAMMALS** | |
| Merriam's shrew | *Sorex merriami* |
| California myotis | *Myotis californicus* |
| small-footed myotis | *Myotis ciliolabrum* |
| long-eared myotis | *Myotis evotis* |
| little brown myotis | *Myotis lucifugus* |
| fringed myotis | *Myotis thysanodes* |
| cave myotis | *Myotis velifer* |
| long-legged myotis | *Myotis volans* |
| Yuma myotis | *Myotis yumanensis* |
| silver-haired bat | *Lasionycteris noctivagans* |
| western pipistrelle | *Pipistrellus hesperus* |
| big brown bat | *Eptesicus fuscus* |
| Pacific Townsend's big-eared bat | *Corynorhinus townsendii townsendii* |
| pale Townsend's big-eared bat | *Corynorhinus towsendii pallescens* |
| spotted bat | *Euderma maculatum* |
| pallid bat | *Antrozous pallidus* |
| Mexican free-tailed bat | *Tadarida brasiliensis* |
| pygmy rabbit | *Brachylagus idahoensis* |
| mountain cottontail | *Sylvilagus nuttallii* |
| black-tailed jackrabbit | *Lepus californicus* |
| yellow-bellied marmot | *Marmota flaviventris* |
| white-tailed antelope squirrel | *Ammospermophilus leucurus* |
| Townsend's ground squirrel | *Spermophilus townsendii* |
| Townsend's pocket gopher | *Thomomys townsendii* |
| northern pocket gopher | *Thomomys talpoides* |
| little pocket mouse | *Perognathus longimembris* |
| Great Basin pocket mouse | *Perognathus parvus* |

| | |
|---|---|
| dark kangaroo mouse | *Microdipodops megacephalus* |
| Ord's kangaroo rat | *Dipodomys ordii* |
| Great Basin kangaroo rat | *Dipodomys microps* |
| Merriam's kangaroo rat | *Dipodomys merriami* |
| western harvest mouse | *Reithrodontomys megalotis* |
| deer mouse | *Peromyscus maniculatus* |
| canyon mouse | *Peromyscus crinitus* |
| northern grasshopper mouse | *Onychomys leucogaster* |
| desert woodrat | *Neotoma lepida* |
| montane vole | *Microtus montanus* |
| long-tailed vole | *Microtus longicaudus* |
| sagebrush vole | *Lagurus curtatus* |
| coyote | *Canis latrans* |
| kit fox | *Vulpes macrotis* |
| badger | *Taxidea taxus* |
| long-tailed weasel | *Mustela frenata* |
| striped skunk | *Mephitis mephitis* |
| raccoon | *Procyon lotor* |
| mountain lion | *Felis concolor* |
| bobcat | *Lynx rufus* |
| western spotted skunk | *Spilogale gracilis* |
| mule deer | *Odocoileus hemionus* |

**REPTILES**

| | |
|---|---|
| zebra-tailed lizard | *Callisaurus draconoides* |
| common collared lizard | *Crotapahytus collaris* |
| black-collared lizard | *Crotaphytus insularis* |
| long-nosed leopard lizard | *Gambelia wislizenii* |
| desert spiny lizard | *Sceloporus magister* |
| western fence lizard | *Sceloporus occidentalis* |

| | |
|---|---|
| sagebrush lizard | *Sceloporus graciosus* |
| side-blotched lizard | *Uta stansburiana* |
| short-horned lizard | *Phrynosoma douglassi* |
| desert horned lizard | *Phrynosoma platyrhinos* |
| western whiptail lizard | *Cnemidophorus tigris* |
| western skink | *Eumeces skiltonianus* |
| striped whipsnake | *Masticophis taeniatus* |
| coachwhip | *Masticophis flagellum* |
| western patch-nosed snake | *Salvadora hexalepis* |
| gopher snake | *Pituophis melanoleucus* |
| common kingsnake | *Lampropeltis getulus* |
| long-nosed snake | *Rhinocheilus lecontei* |
| garter snake | *Thamnophis elegans* |
| night snake | *Hypsiglena torquata* |
| western rattlesnake | *Crotalus viridis* |

**BIRDS**

| | |
|---|---|
| least bittern | *Ixobrychus exilis hesperis* |
| white-faced ibis | *Pleqadis chihi* |
| black tern | *Chlidonias niger* |
| Swainson's hawk | *Buteo swainsoni* |
| red-tailed hawk | *Buteo jamaicensis* |
| ferruginous hawk | *Buteo regalis* |
| rough-legged hawk | *Buteo lagopus* |
| golden eagle | *Aquila chrysaetos* |
| bald eagle | *Haliaeetus leucocephalus* |
| turkey vulture | *Cathartes aura* |
| American kestrel | *Falco sparverius* |
| peregrine falcon | *Falco peregrinus anatum* |
| prairie falcon | *Falco mexicanus* |

| | |
|---|---|
| northern goshawk | *Accipiter gentilis* |
| Cooper's hawk | *Accipiter cooperii* |
| sharp-shinned hawk | *Accipiter striatus* |
| northern harrier | *Circus cyaneus* |
| sage grouse | *Centrocercus urophasianus* |
| California quail | *Callipepla californica* |
| mountain quail | *Oreortyx pictus* |
| chukar | *Alectoris chukar* |
| killdeer | *Charadrius vociferus* |
| mourning dove | *Zenaida macroura* |
| great horned owl | *Bubo virginianus* |
| burrowing owl | *Athene cunicularia* |
| short-eared owl | *Asio flammeus* |
| common nighthawk | *Chordeiles minor* |
| common poorwill | *Phalaenoptilus nuttallii* |
| black-chinned hummingbird | *Archilochus alexandri* |
| gray flycatcher | *Empidonax wrightii* |
| Say's phoebe | *Sayornis saya* |
| western kingbird | *Tyrannus verticalis* |
| ash-throated flycatcher | *Myiarchus cinerascens* |
| horned lark | *Eremophila alpestris* |
| violet-green swallow | *Tachycineta thalassina* |
| cliff swallow | *Hirundo pyrrhonota* |
| barn swallow | *Hirundo rustica* |
| white-throated swift | *Aeronautes saxatalis* |
| black-billed magpie | *Pica pica* |
| common raven | *Corvus corax* |
| rock wren | *Salpinctes obsoletus* |
| mountain bluebird | *Sialia currucoides* |
| western bluebird | *Sialia mexicana* |

Appendix C (Continued)

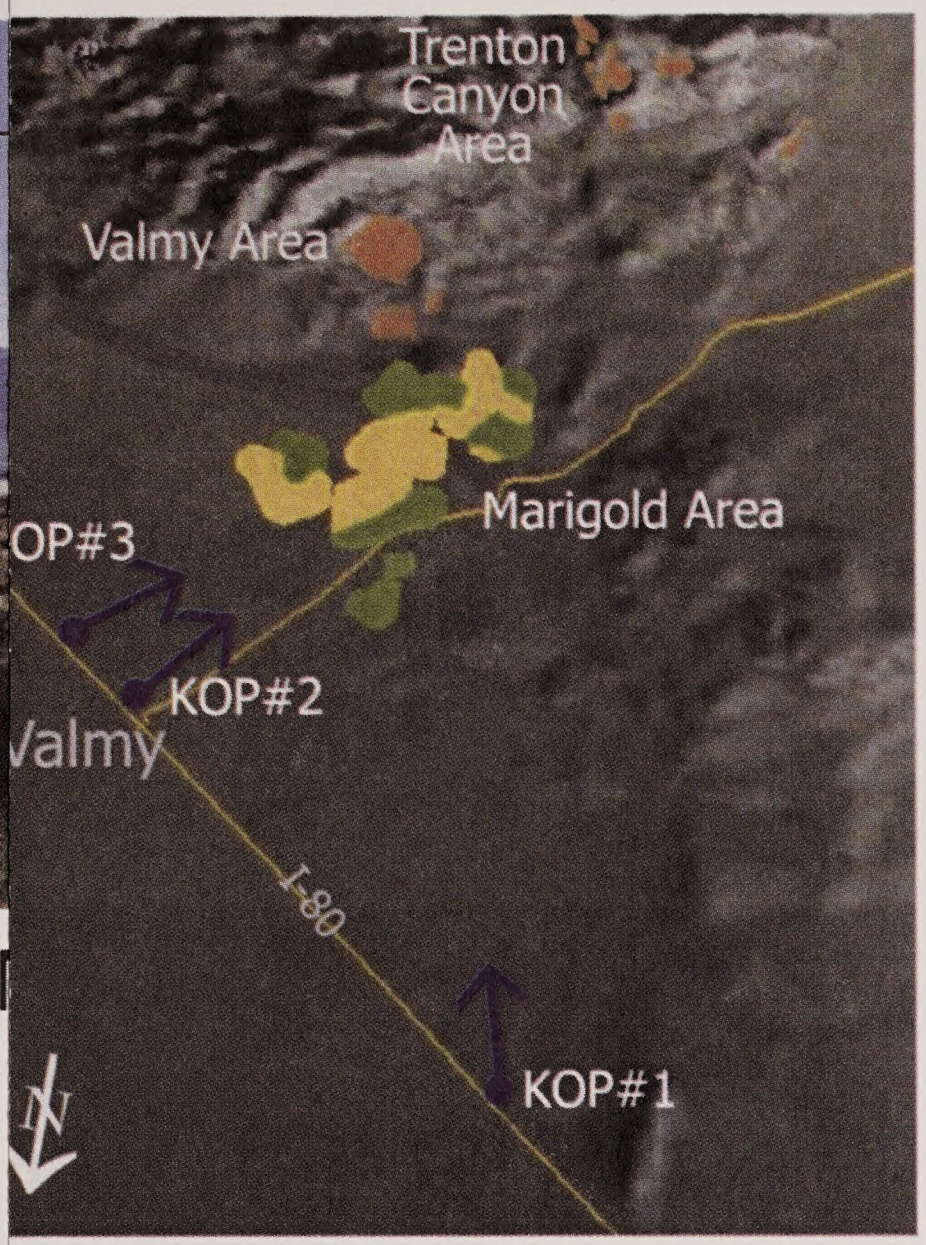
| | |
|---|---|
| Townsend's solitaire | *Myadestes townsendi* |
| American robin | *Turdus migratorius* |
| cedar waxwing | *Bombycilla cedrorum* |
| loggerhead shrike | *Lanius ludovicianus* |
| sage thrasher | *Oreoscoptes montanus* |
| European starling | *Sturnus vulgaris* |
| black-throated gray warbler | *Dendroica nigrescens* |
| warbling vireo | *Vireo gilvus* |
| lazuli bunting | *Passerina amoena* |
| northern oriole | *Icterus galbula* |
| green-tailed towhee | *Pipilo chlorurus* |
| spotted towhee | *Pipilo erythrophthalmus* |
| Brewer's sparrow | *Spizella breweri* |
| American tree sparrow | *Spizella arborea* |
| vesper sparrow | *Pooecetes gramineus* |
| lark sparrow | *Chondestes grammacus* |
| chipping sparrow | *Spizella passerina* |
| savannah sparrow | *Passerculus sandwichensis* |
| grasshopper sparrow | *Ammodramus savannarum* |
| black-throated sparrow | *Amphispiza bilineata* |
| sage sparrow | *Amphispiza belli* |
| Lapland longspur | *Calcarius lapponicus* |
| western meadowlark | *Sturnella neglecta* |
| Brewer's blackbird | *Euphagus cyanocephalus* |
| blue-gray gnatcatcher | *Polioptila caerulea* |
| bushtit | *Psaltriparus minimus* |
| northern flicker | *Colaptes auratus* |
| western tanager | *Piranga ludoviciana* |
| house sparrow | *Passer domesticus* |
| American goldfinch | *Carduelis tristis* |
| house finch | *Carpodacus mexicanus* |

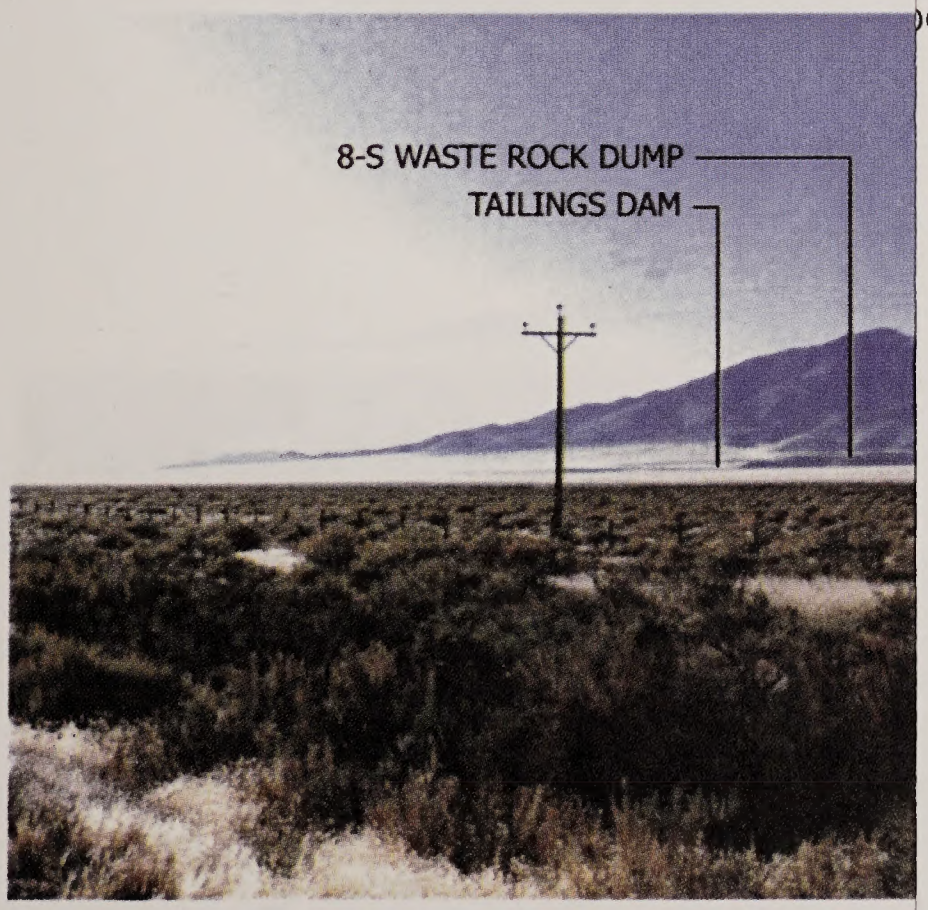
# APPENDIX D

# VISUAL SIMULATIONS AND BLM VISUAL CONTRAST RATING WORKSHEETS




Simulation of Height of




Existing Conditions Phot

Note: For proper scale size, view images at 16"

ocation Map

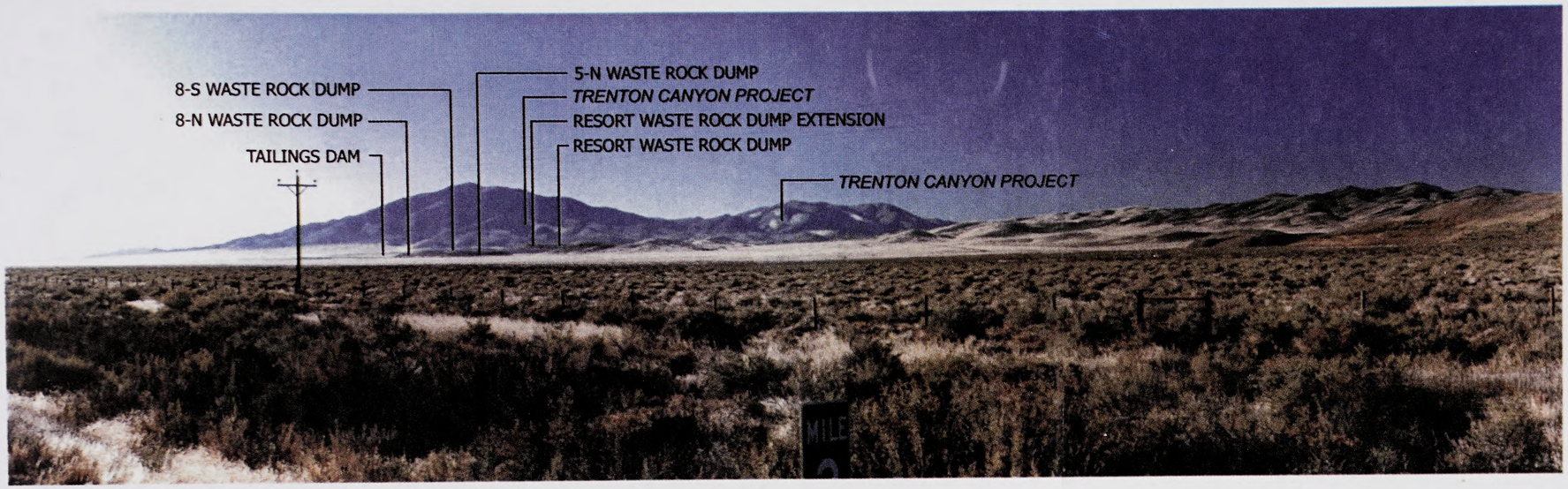
- Existing Marigold Mine Features
- Proposed Marigold Mine Features
- Proposed Trenton Canyon Project Features

# SIMULATION OF HEIGHT OF MINING CONDITIONS
# STONEHOUSE, KOP#1

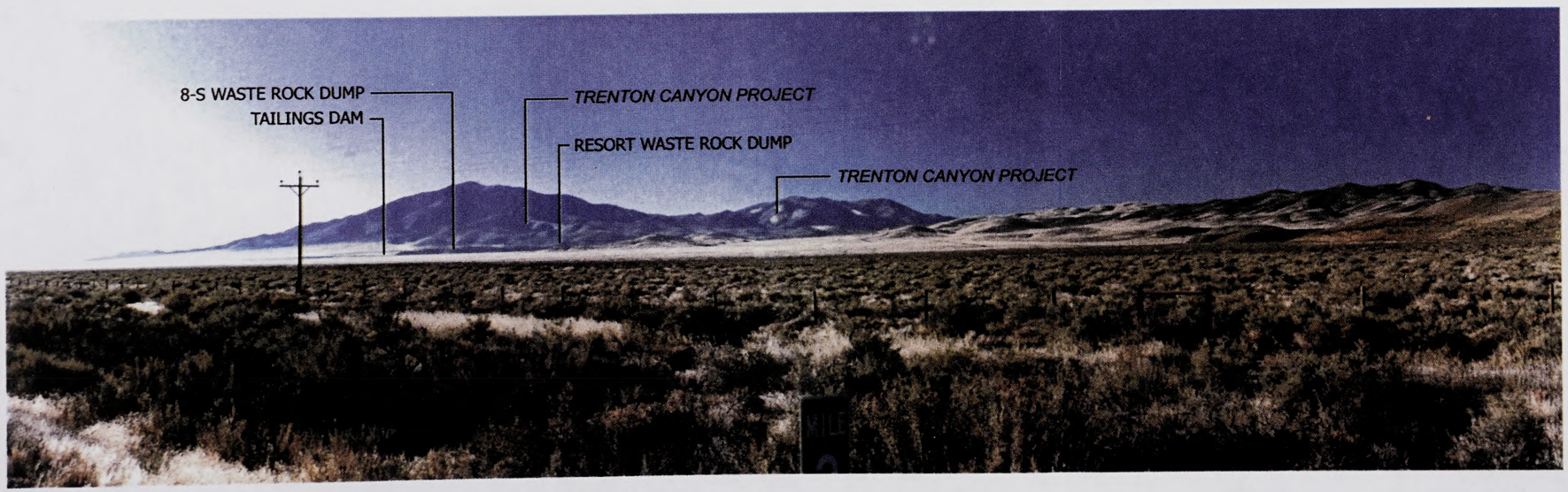
MARIGOLD MINE PROJECT
HUMBOLDT COUNTY, NV

EDAW
May 2000

**D-1**

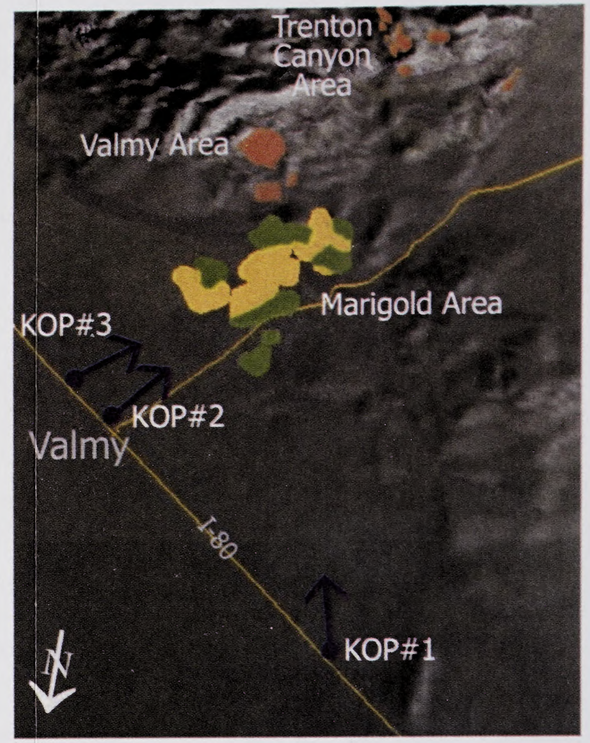



Simulation of Height of Mining Conditions




Existing Conditions Photograph

Note: For proper scale size, view images at 16" from eye.




Location Map

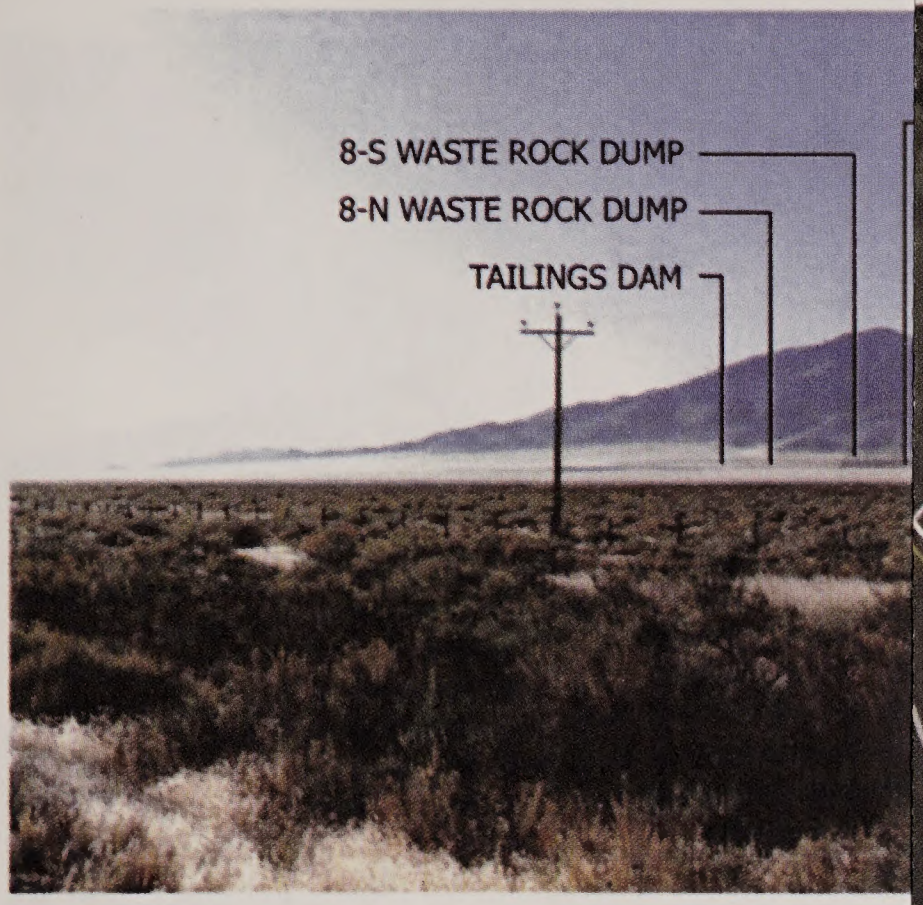
- Existing Marigold Mine Features
- Proposed Marigold Mine Features
- Proposed Trenton Canyon Project Features

# SIMULATION OF HEIGHT OF MINING CONDITIONS
# STONEHOUSE, KOP#1

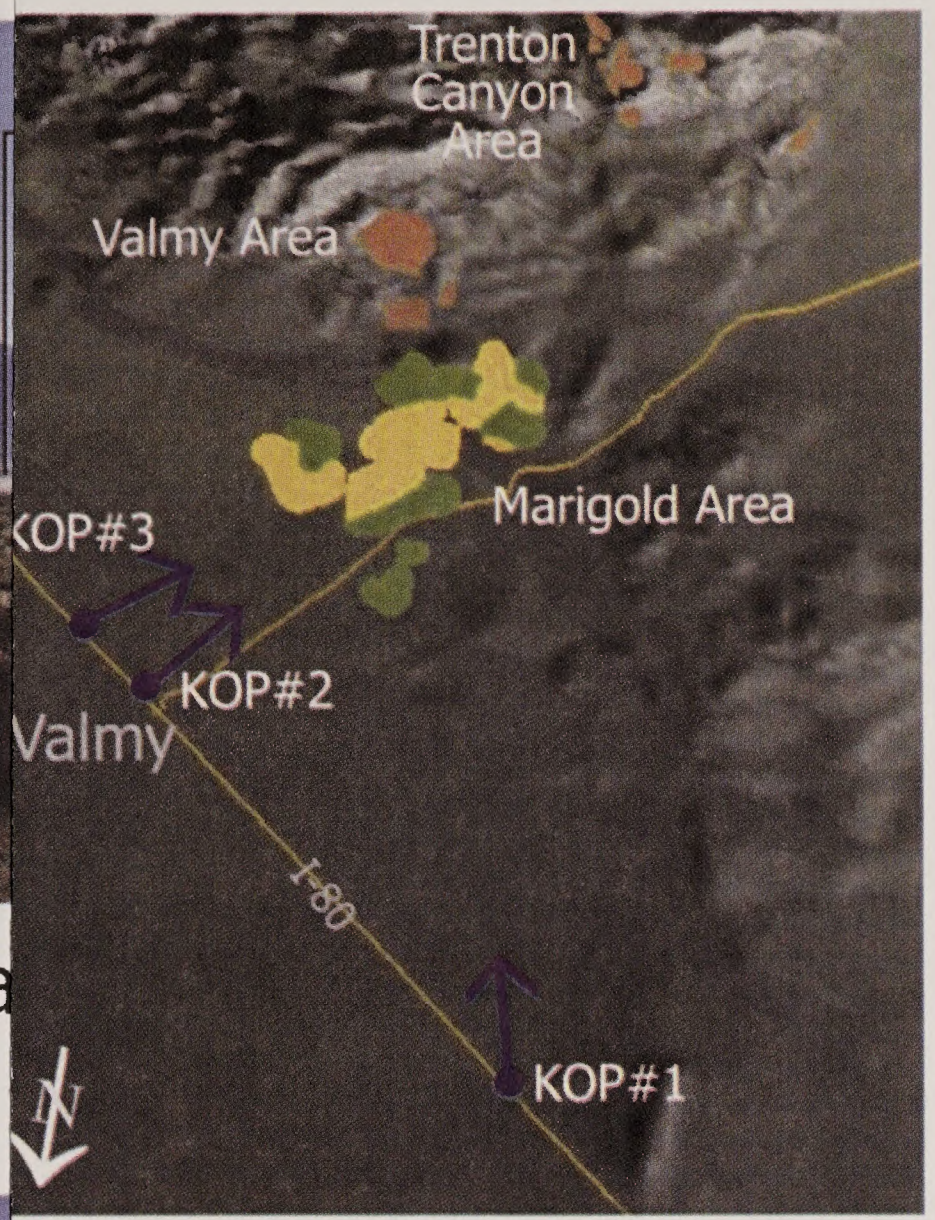
MARIGOLD MINE PROJECT
HUMBOLDT COUNTY, NV

EDAW
May 2000

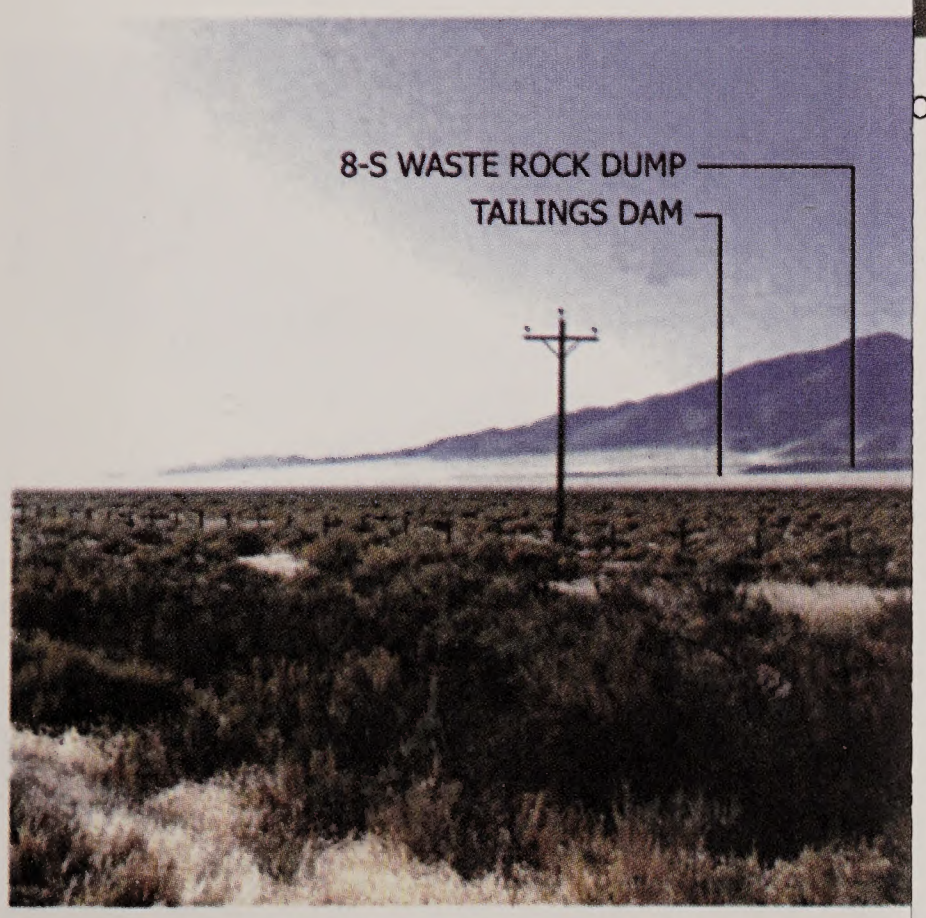
**D-1**




Simulation of Post-Recla




ocation Map




Existing Conditions Phot

Existing Marigold Mine Features

Proposed Marigold Mine Features

Proposed Trenton Canyon Project Features

# SIMULATION OF POST-RECLAMATION CONDITIONS
# STONEHOUSE, KOP#1

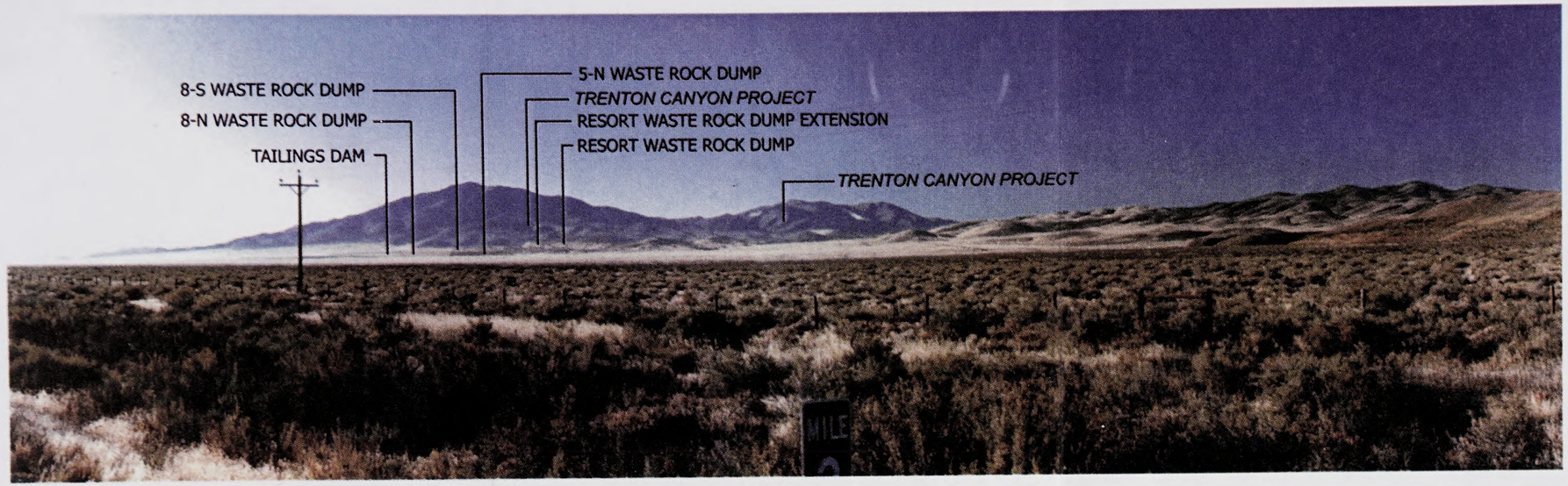
## MARIGOLD MINE PROJECT
HUMBOLDT COUNTY, NV

Note: For proper scale size, view images at 16"

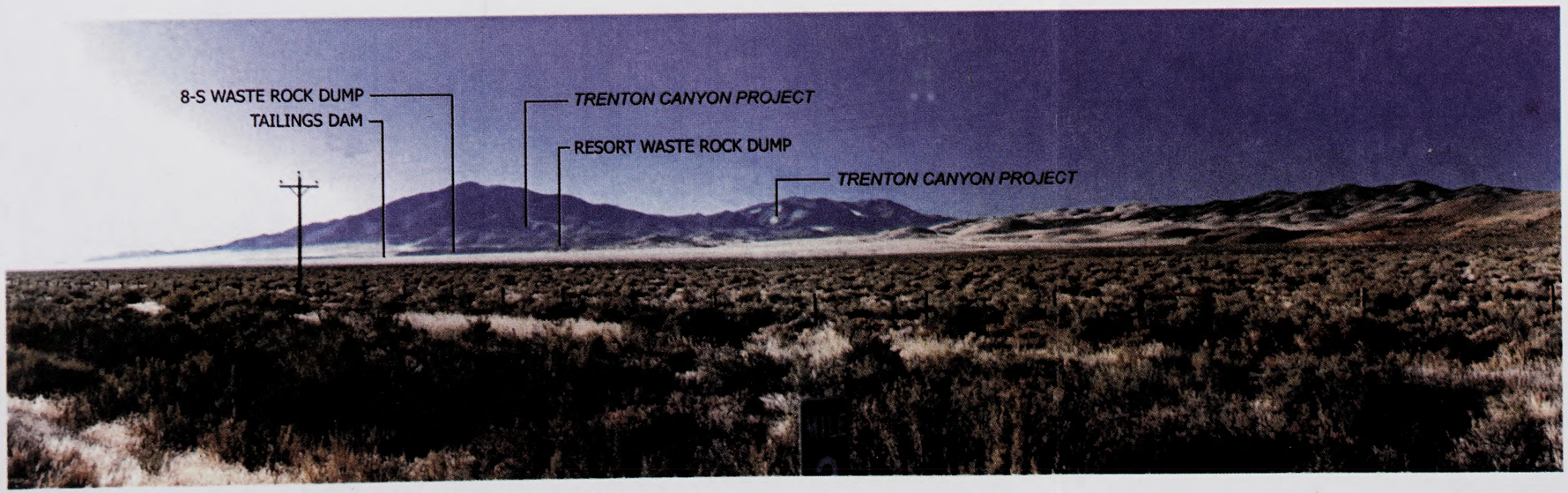
EDAW

May 2000

**D-2**

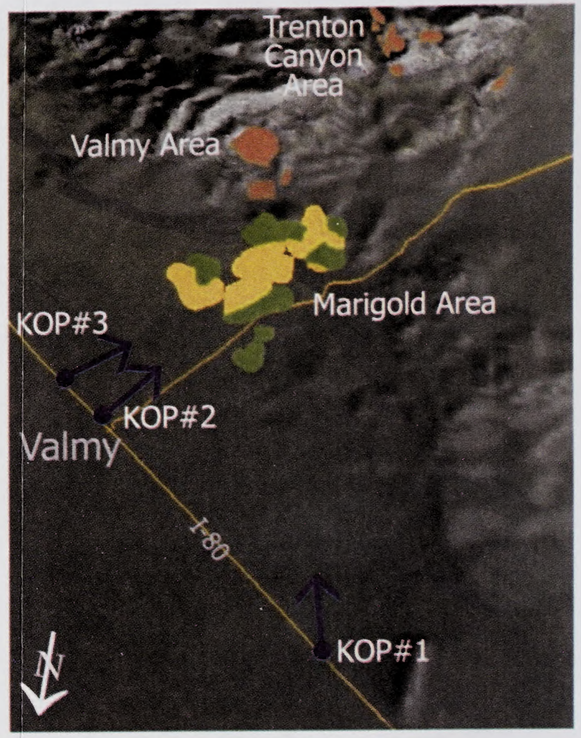



Simulation of Post-Reclamation Conditions




Existing Conditions Photograph

Note: For proper scale size, view images at 16" from eye.




Location Map

- Existing Marigold Mine Features
- Proposed Marigold Mine Features
- Proposed Trenton Canyon Project Features

# SIMULATION OF POST-RECLAMATION CONDITIONS
# STONEHOUSE, KOP#1

MARIGOLD MINE PROJECT
HUMBOLDT COUNTY, NV

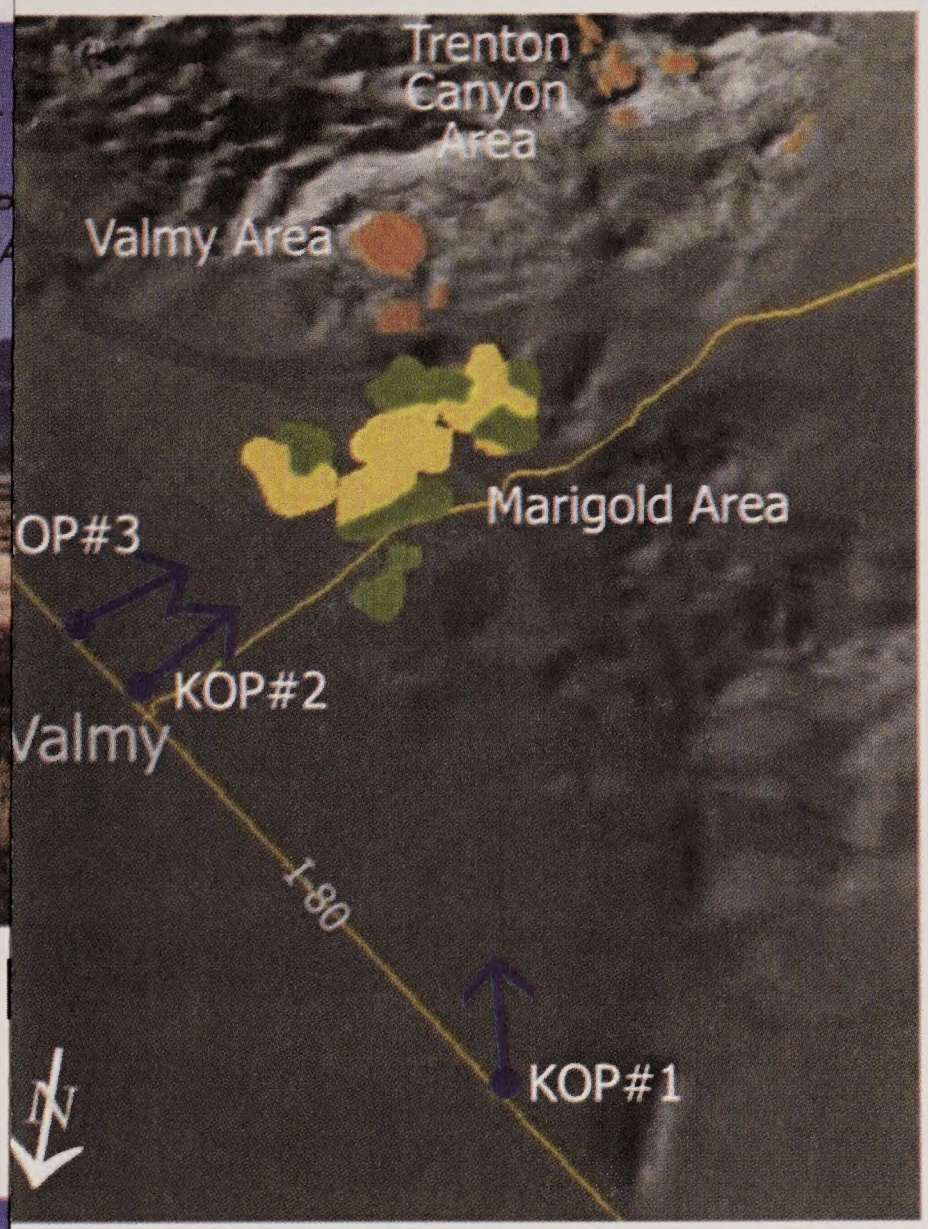
EDAW

May 2000

**D-2**




Simulation of Height of







Existing Conditions Phot

Note: For proper scale size, view images at 16"

ocation Map

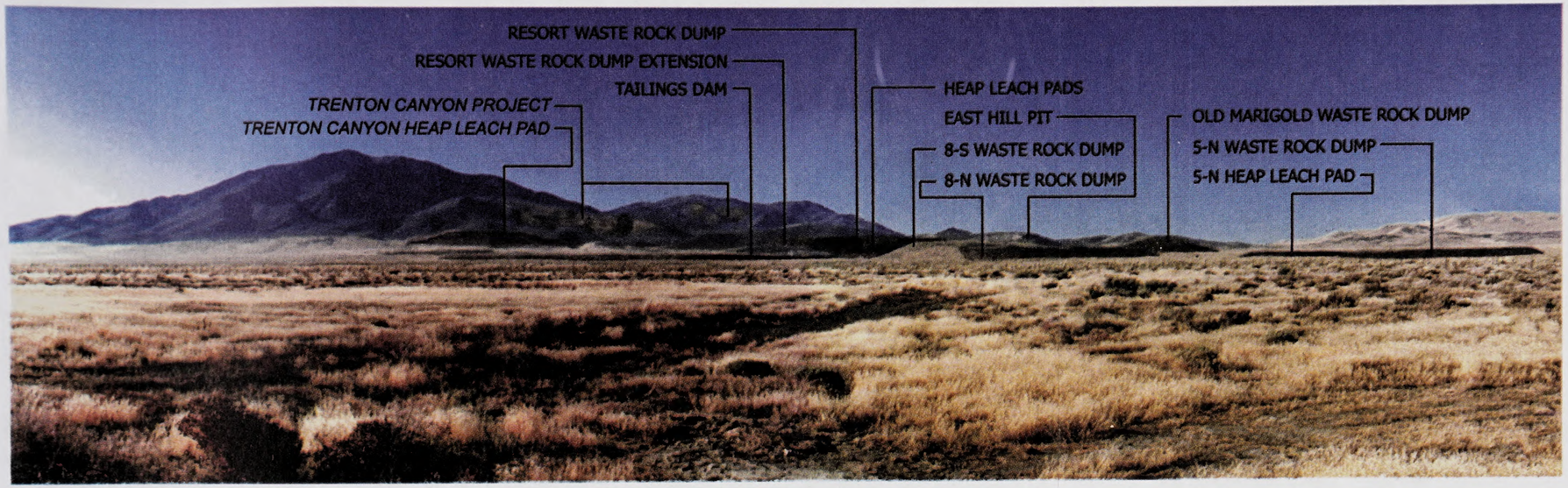
- Existing Marigold Mine Features
- Proposed Marigold Mine Features
- Proposed Trenton Canyon Project Features

# SIMULATION OF HEIGHT OF MINING CONDITIONS
# VALMY, KOP#2

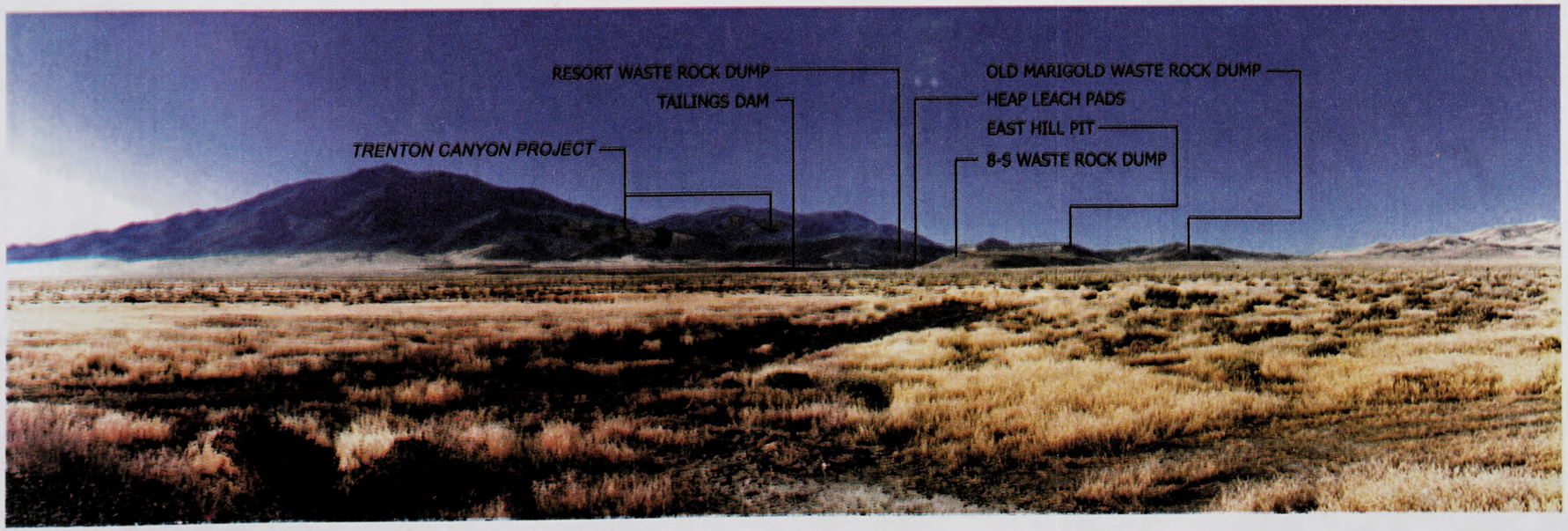
MARIGOLD MINE PROJECT
HUMBOLDT COUNTY, NV

EDAW
May 2000

D-3

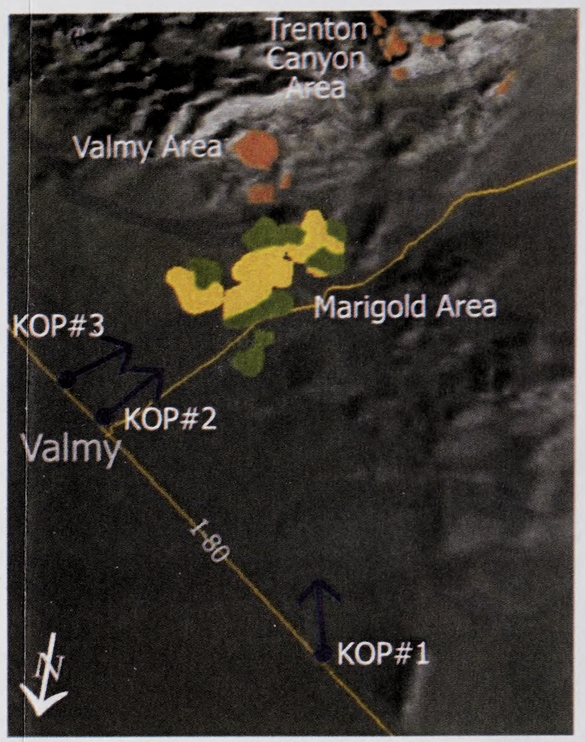



Simulation of Height of Mining Conditions




Existing Conditions Photograph

Note: For proper scale size, view images at 16" from eye.




Location Map

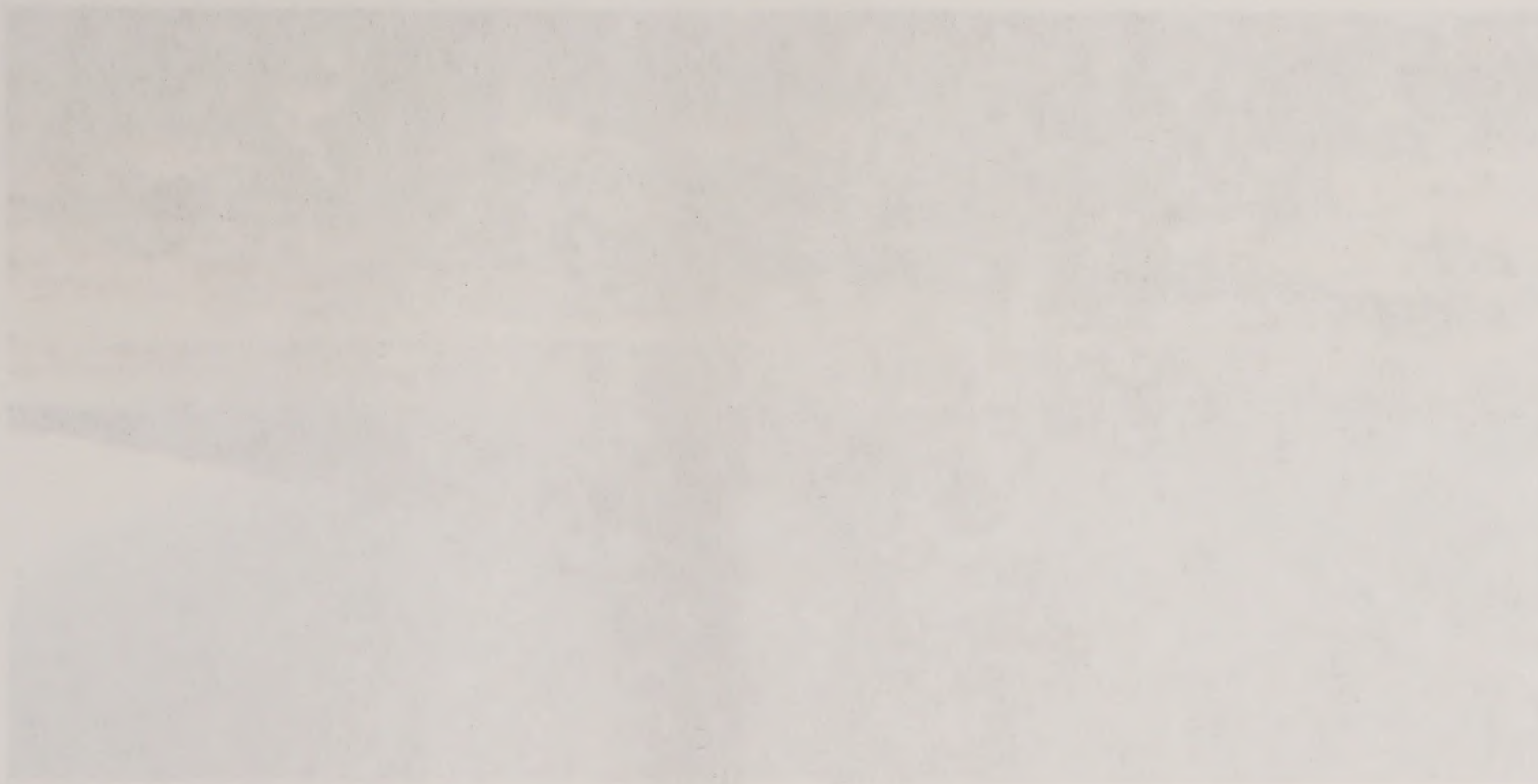
- Existing Marigold Mine Features
- Proposed Marigold Mine Features
- Proposed Trenton Canyon Project Features

# SIMULATION OF HEIGHT OF MINING CONDITIONS
# VALMY, KOP#2

MARIGOLD MINE PROJECT
HUMBOLDT COUNTY, NV

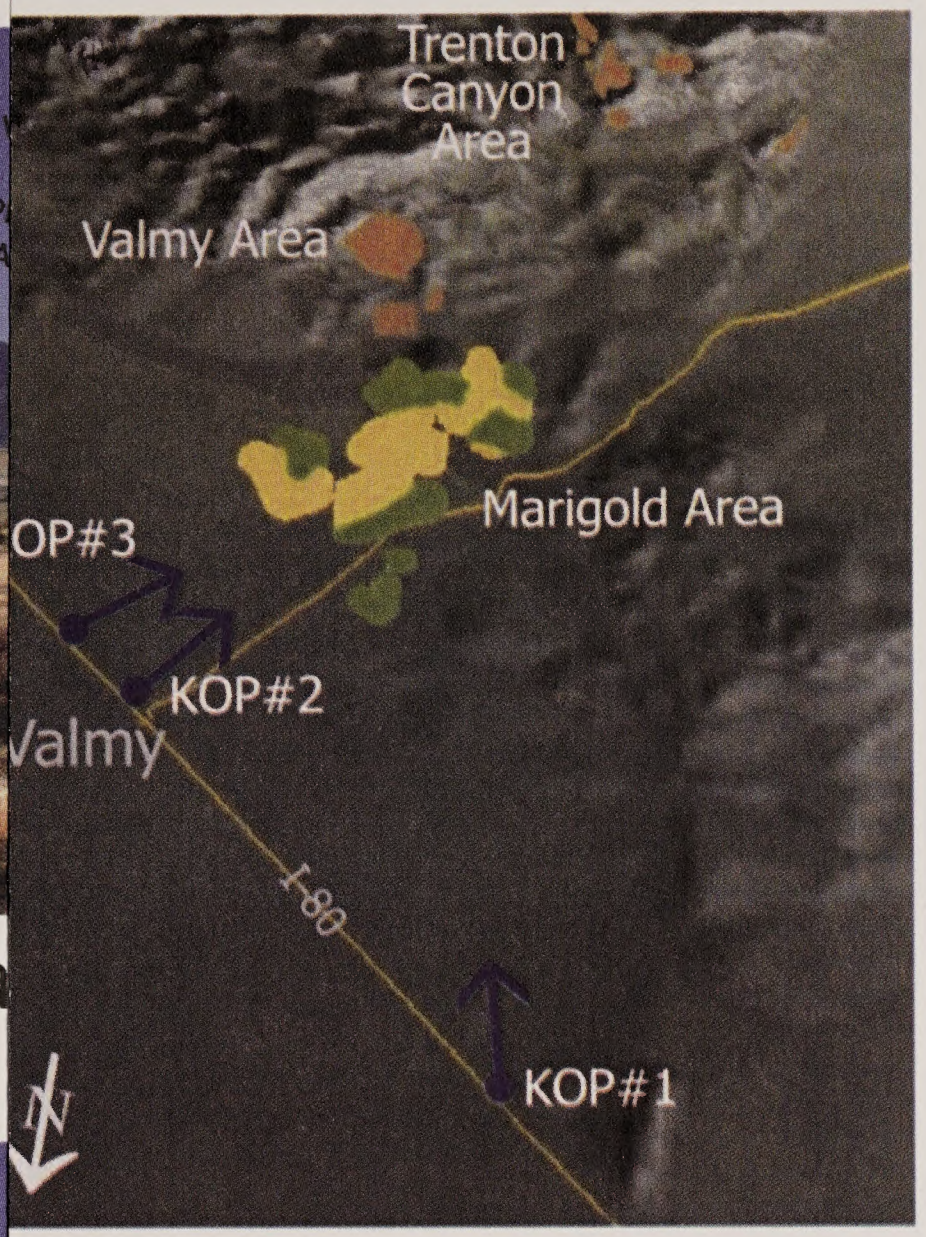
EDAW
May 2000

D-3



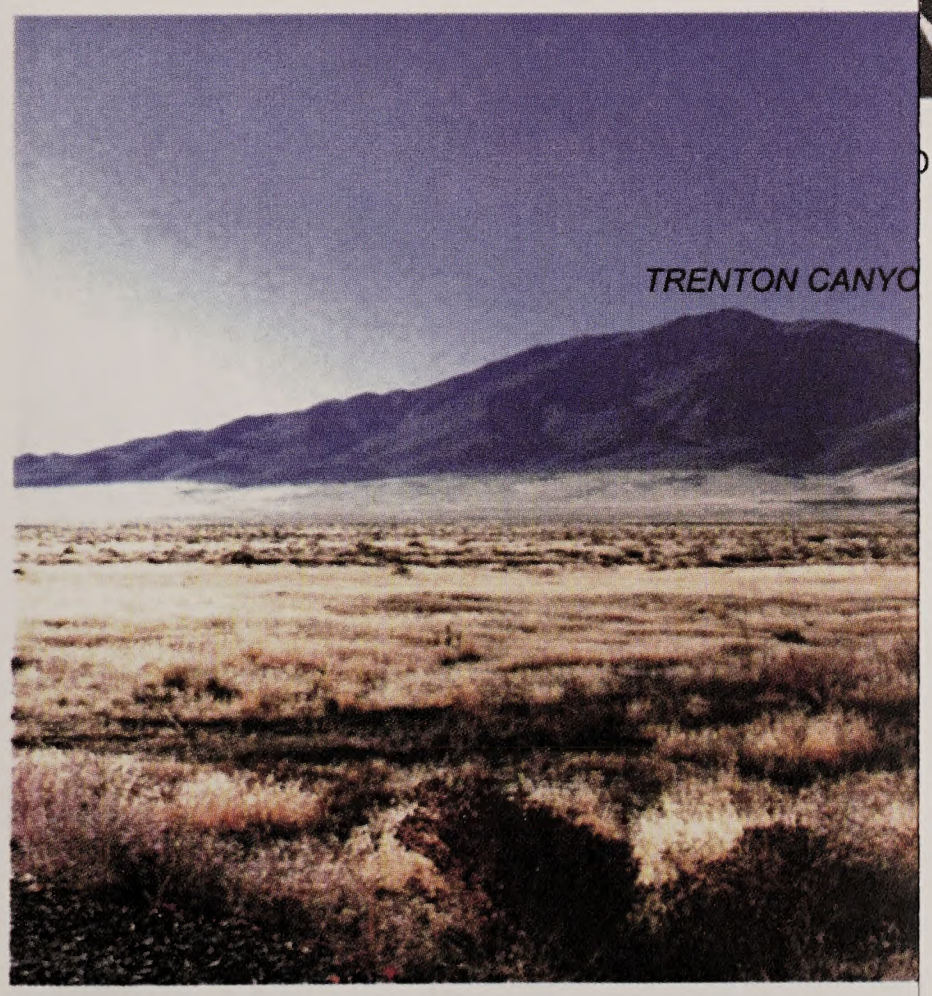



Simulation of Post-Recla




ocation Map

- Existing Marigold Mine Features
- Proposed Marigold Mine Features
- Proposed Trenton Canyon Project Features




Existing Conditions Phot

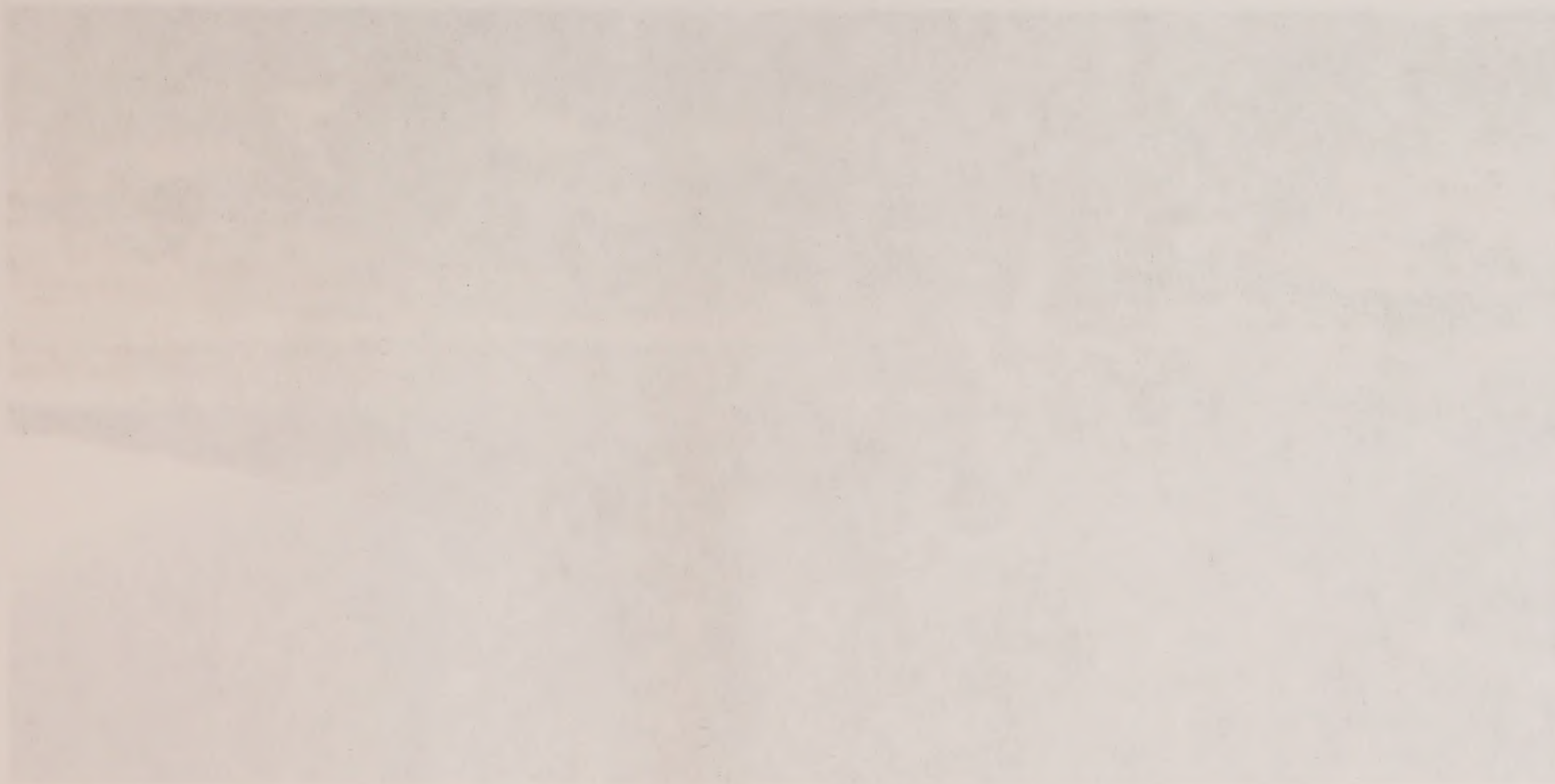
Note: For proper scale size, view images at 16"

# SIMULATION OF POST-RECLAMATION CONDITIONS
# VALMY, KOP#2

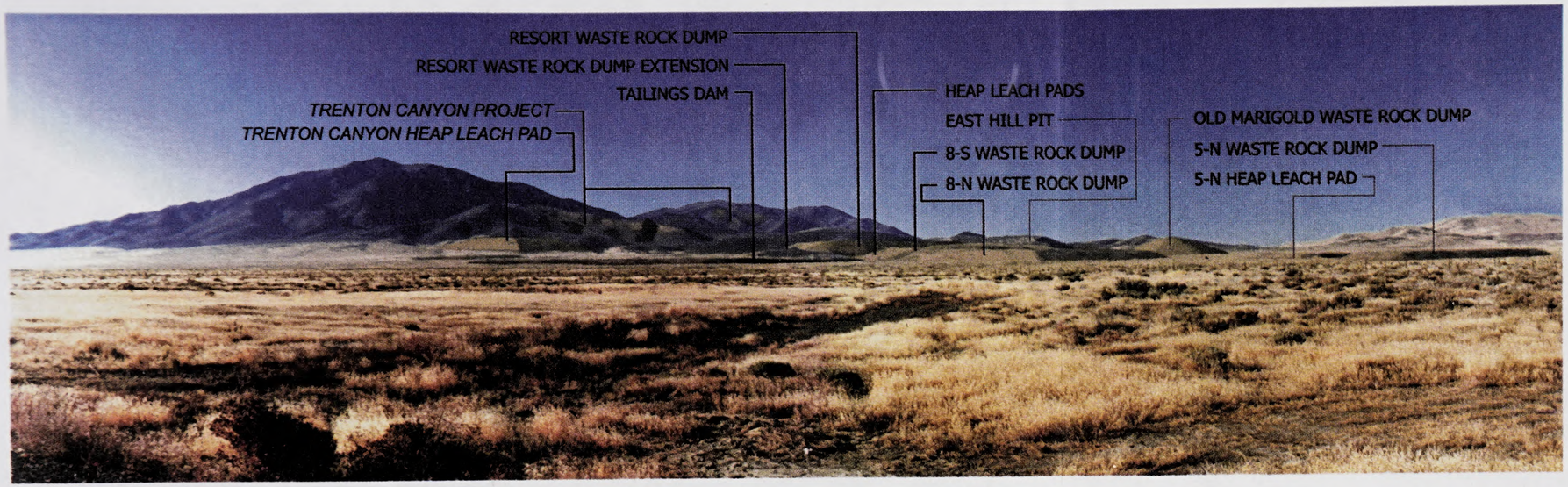
## MARIGOLD MINE PROJECT
HUMBOLDT COUNTY, NV

EDAW
May 2000

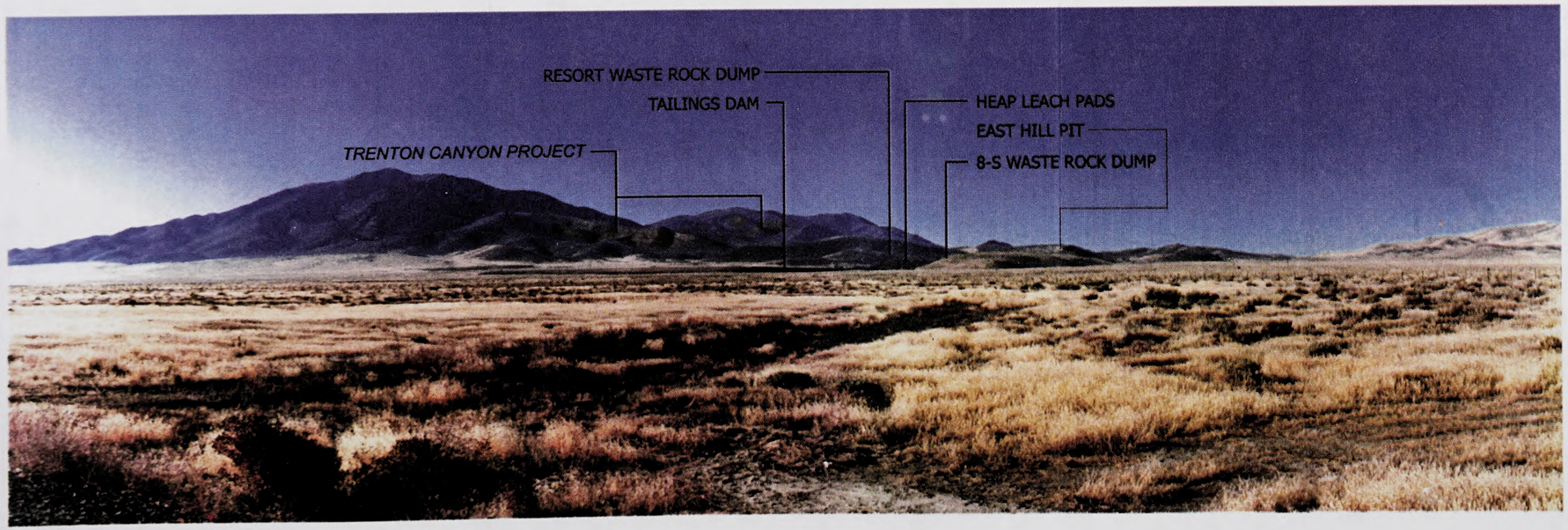
D-4





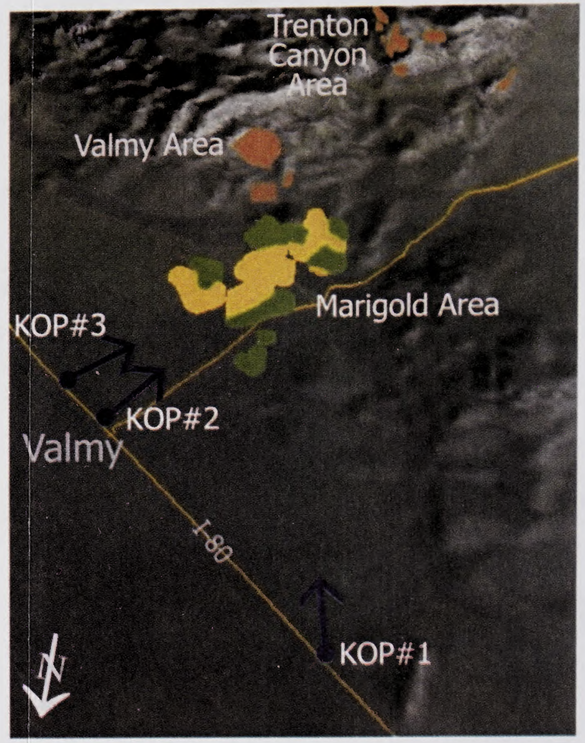



Simulation of Post-Reclamation Conditions




Existing Conditions Photograph

Note: For proper scale size, view images at 16" from eye.




Location Map

- Existing Marigold Mine Features
- Proposed Marigold Mine Features
- Proposed Trenton Canyon Project Features

SIMULATION OF POST-RECLAMATION CONDITIONS

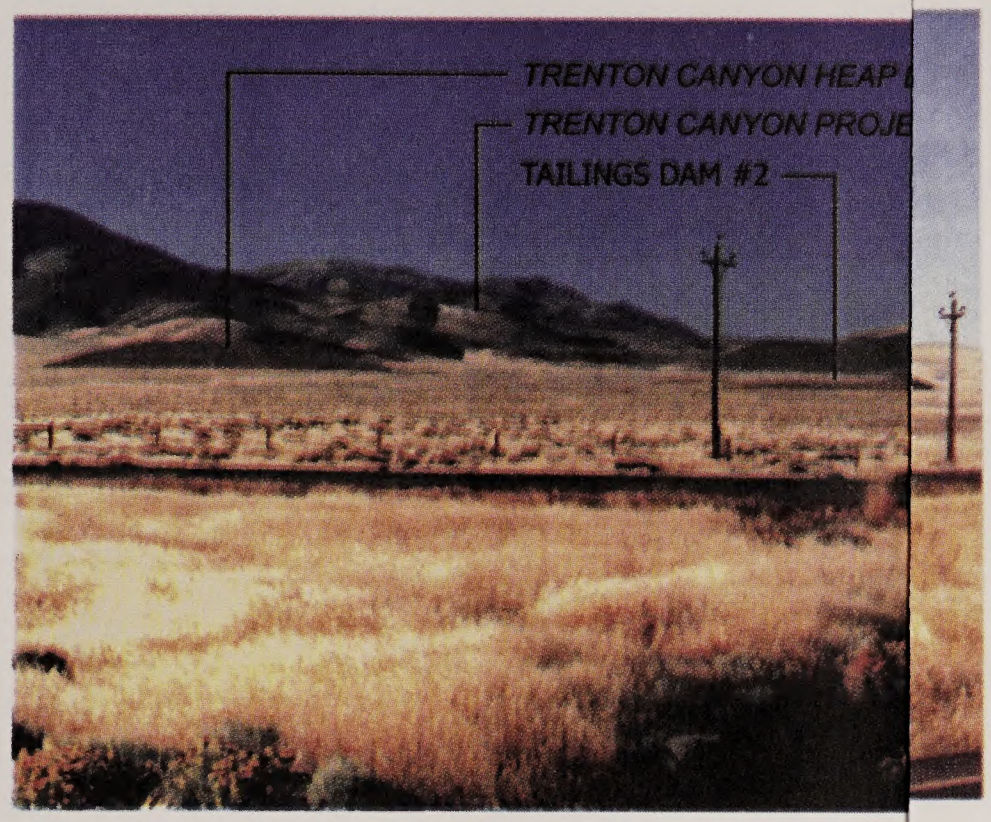
VALMY, KOP#2

MARIGOLD MINE PROJECT
HUMBOLDT COUNTY, NV

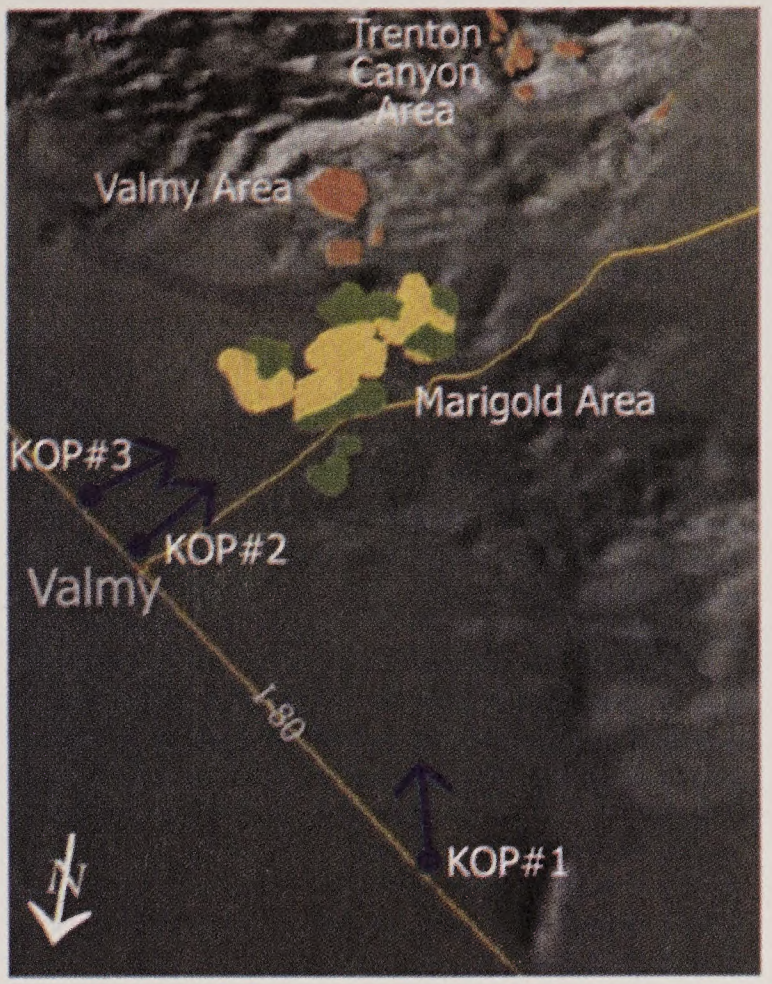
EDAW
May 2000

D-4



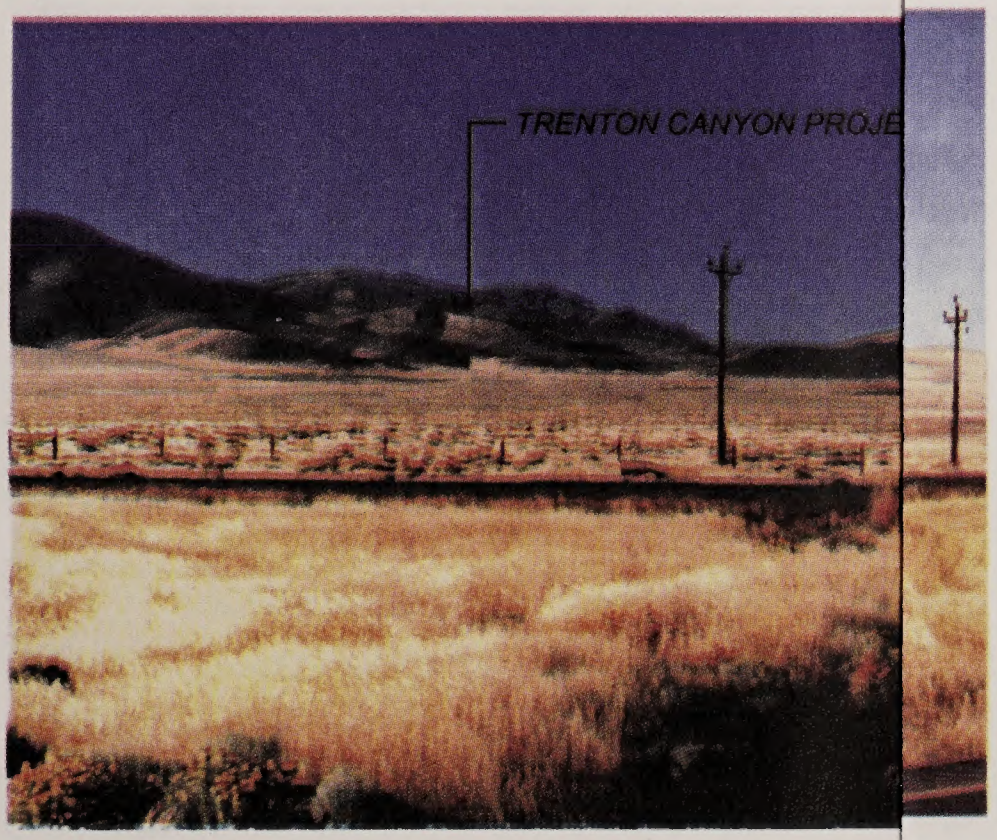



Simulation of Height of




Location Map

- Existing Marigold Mine Features
- Proposed Marigold Mine Features
- Proposed Trenton Canyon Project Features




Existing Conditions Phot

Note: For proper scale size, view images at 16'

SIMULATION OF HEIGHT OF MINING CONDITIONS

SOUTH OF VALMY, KOP#3

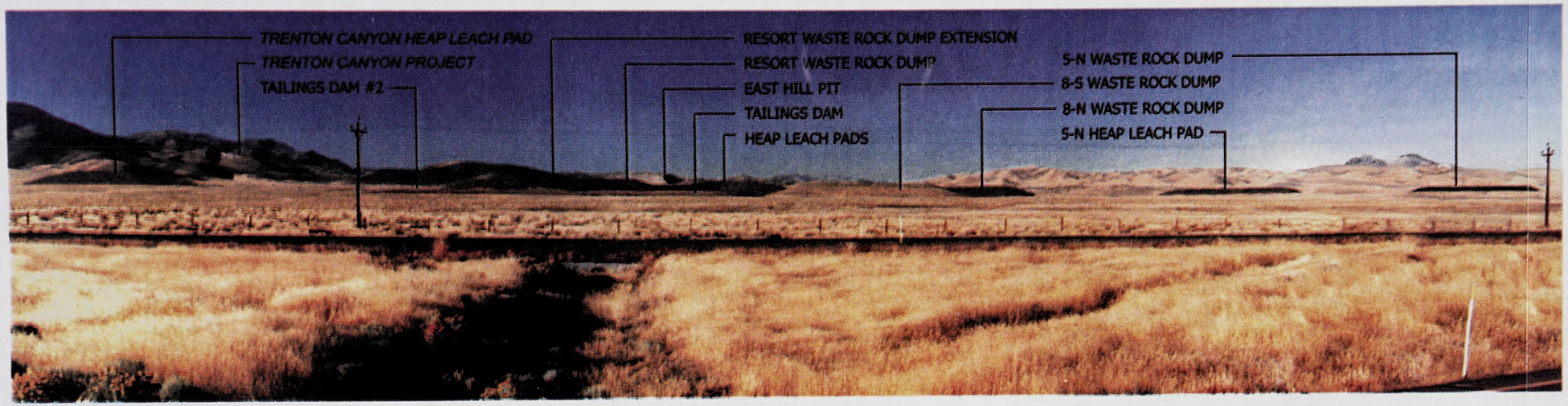
MARIGOLD MINE PROJECT
HUMBOLDT COUNTY, NV

EDAW

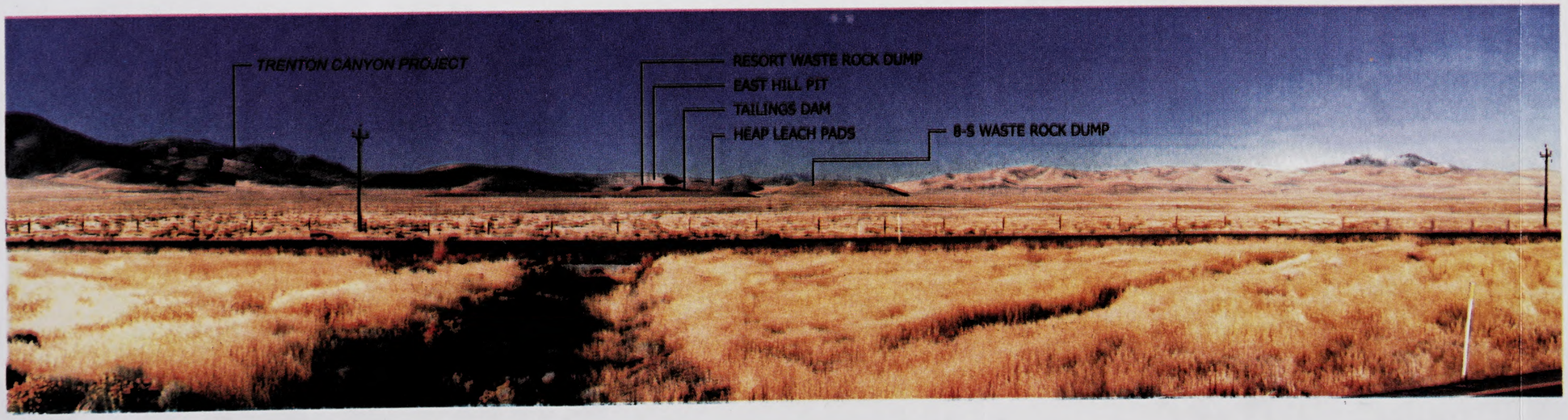
May 2000

D-5



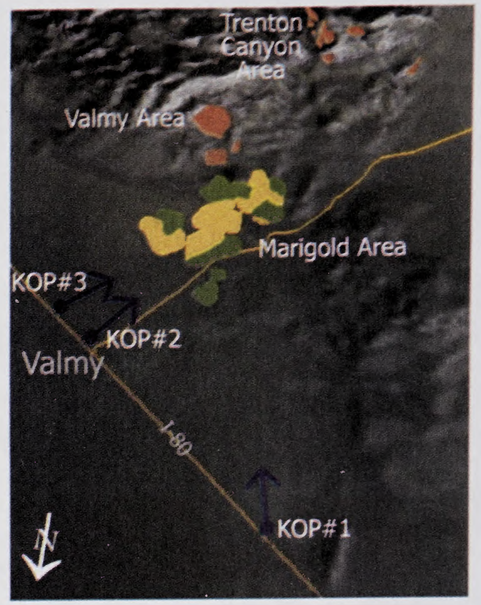



Simulation of Height of Mining Conditions




Existing Conditions Photograph

Note: For proper scale size, view images at 16" from eye.




Location Map

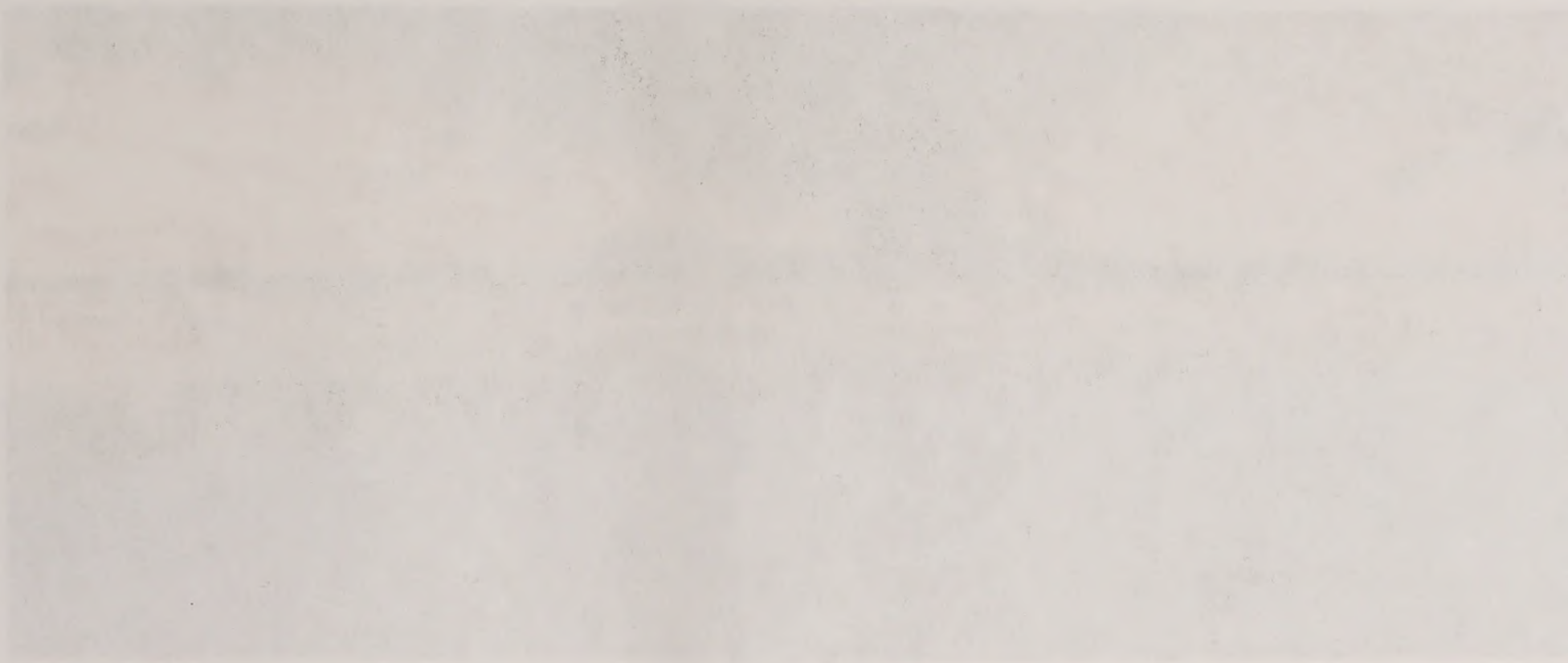
- Existing Marigold Mine Features
- Proposed Marigold Mine Features
- Proposed Trenton Canyon Project Features

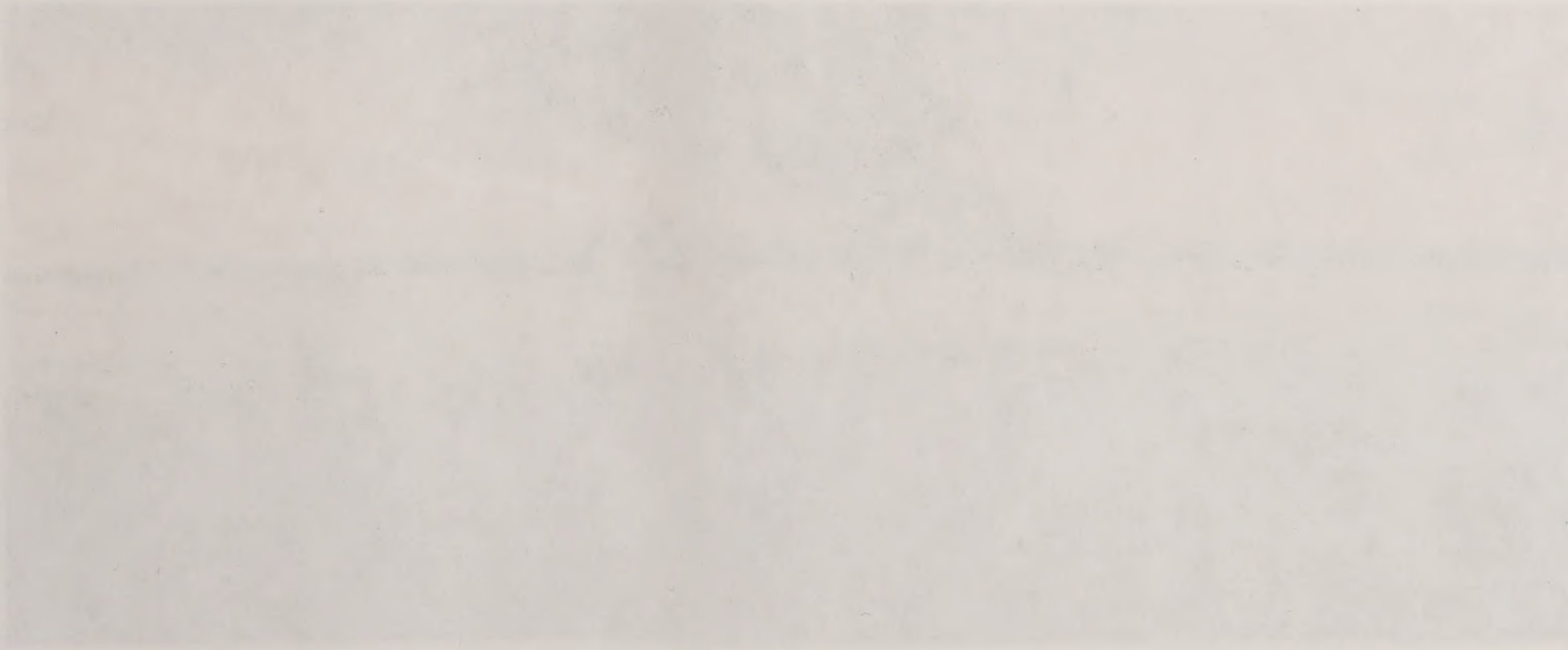
SIMULATION OF HEIGHT OF MINING CONDITIONS
SOUTH OF VALMY, KOP#3

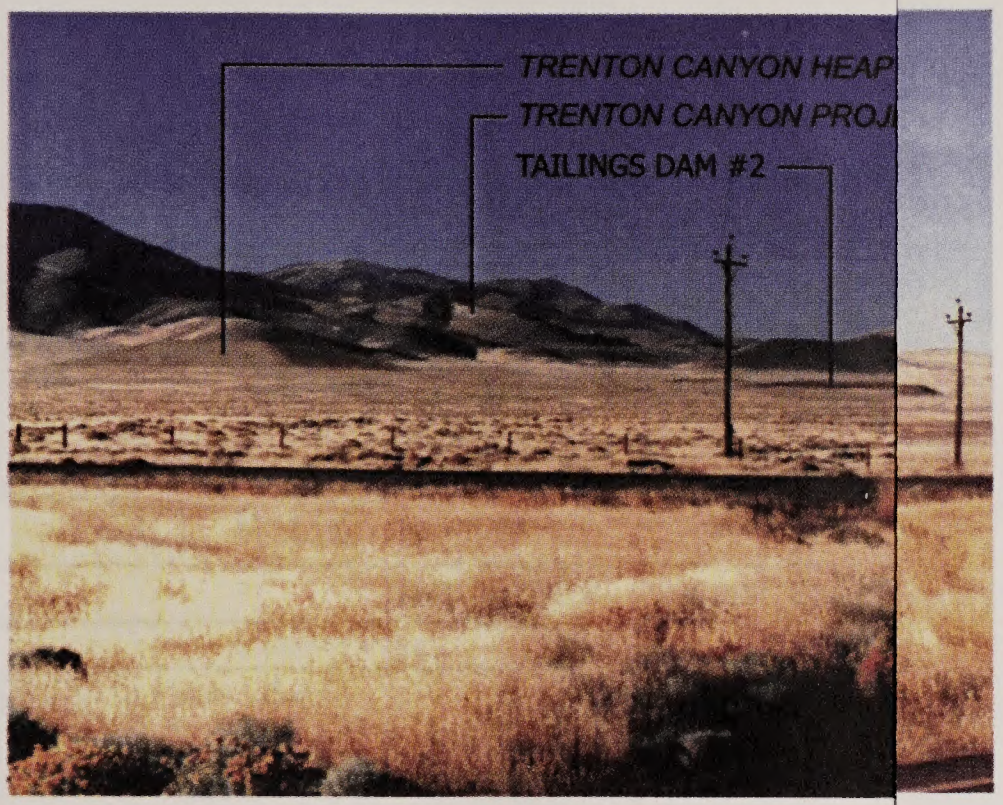
MARIGOLD MINE PROJECT
HUMBOLDT COUNTY, NV

EDAW
May 2000

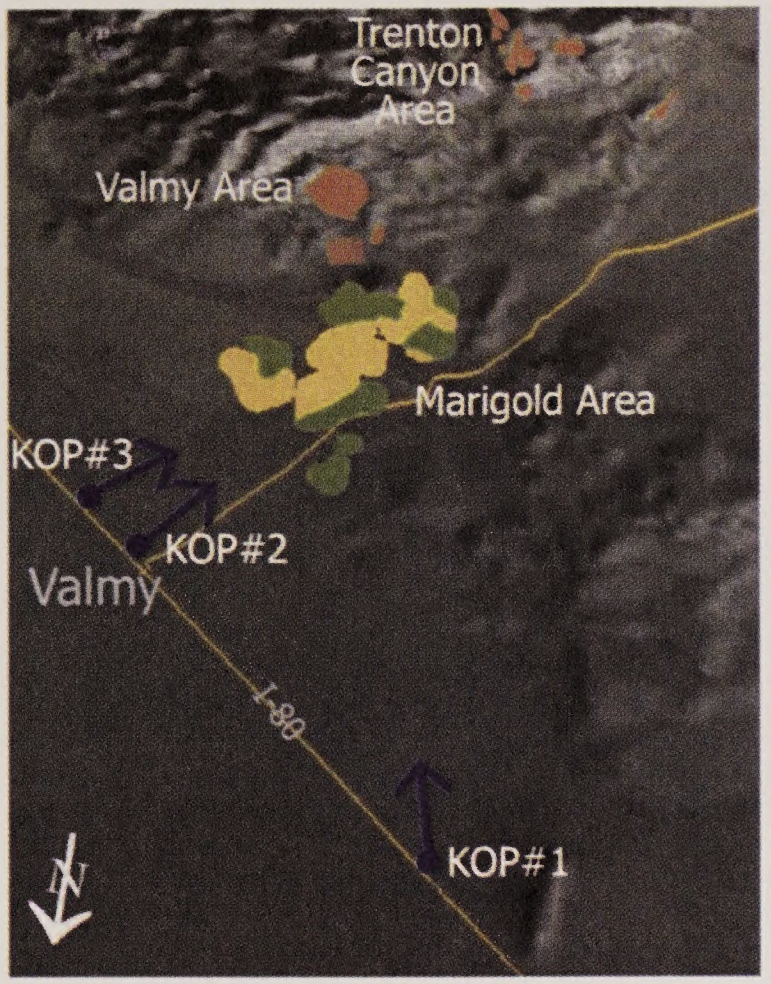
D-5





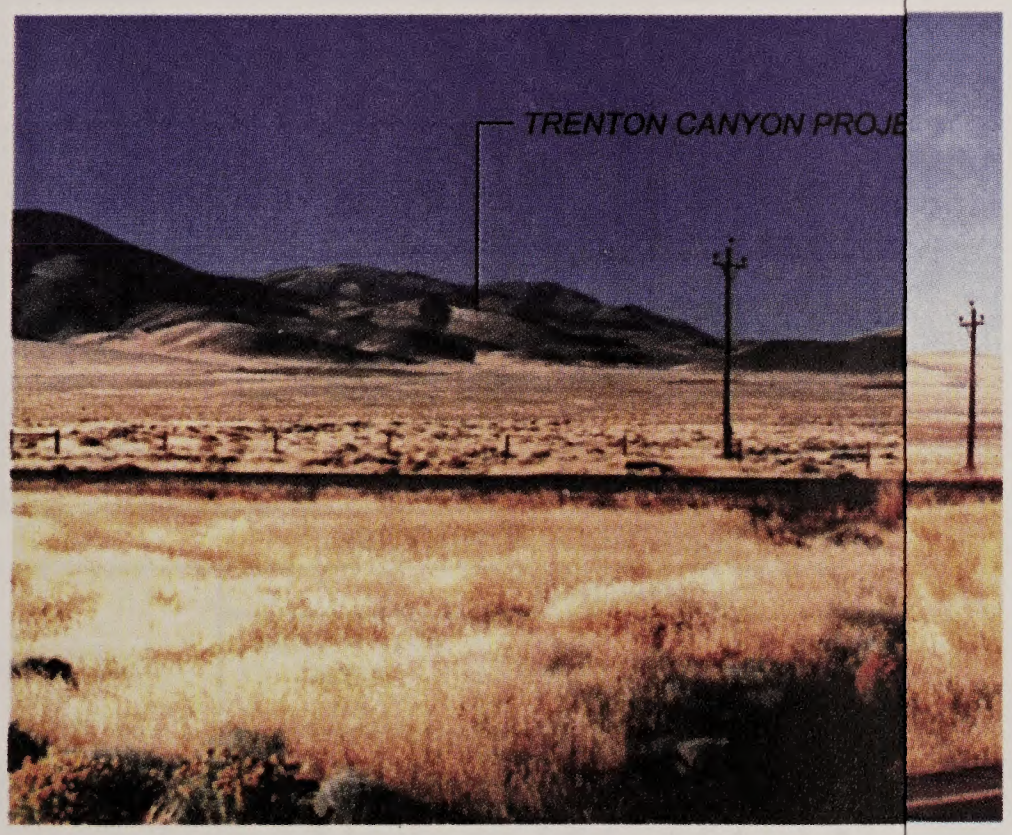



Simulation of Post-Recla




Location Map

- Existing Marigold Mine Features
- Proposed Marigold Mine Features
- Proposed Trenton Canyon Project Features




Existing Conditions Pho

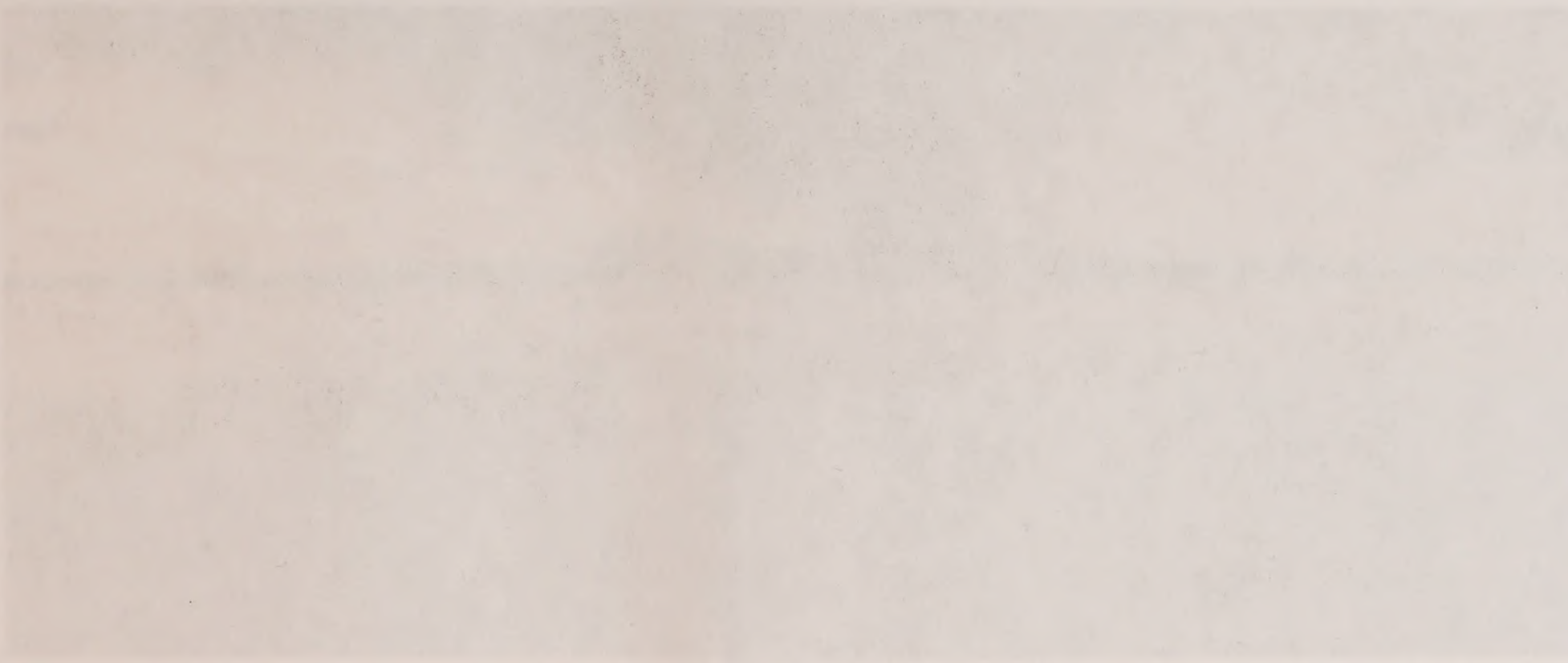
Note: For proper scale size, view images at 16

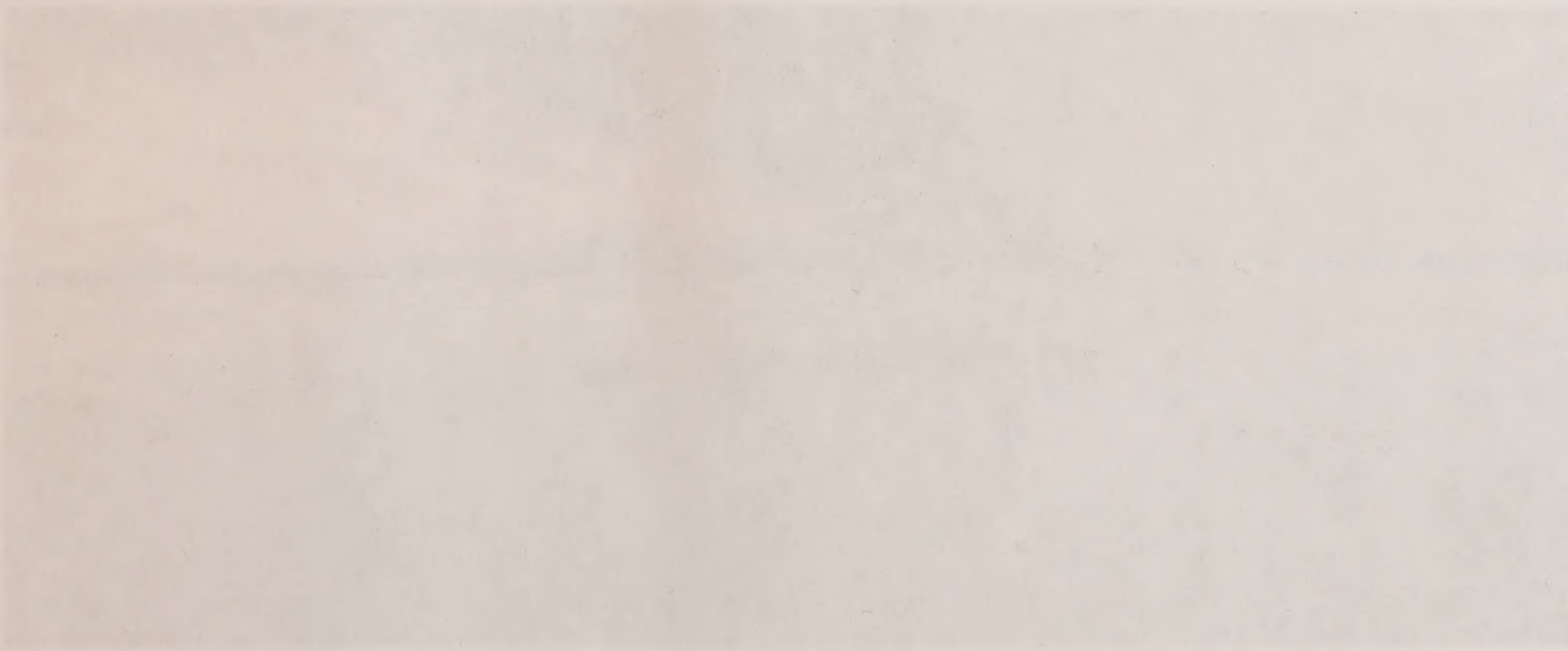
SIMULATION OF POST-RECLAMATION CONDITIONS
SOUTH OF VALMY, KOP#3

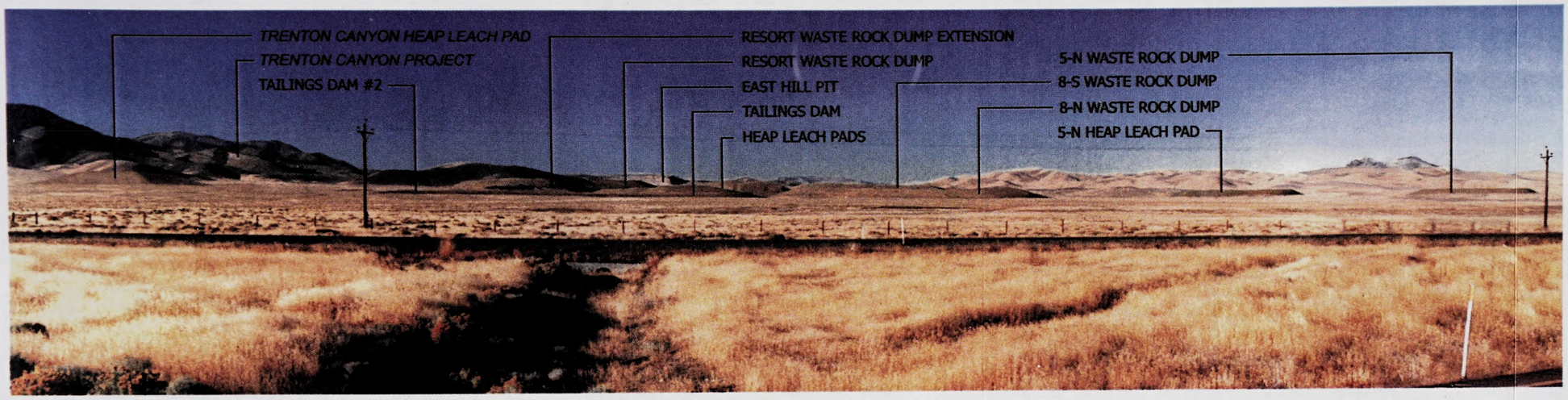
MARIGOLD MINE PROJECT
HUMBOLDT COUNTY, NV

EDAW
May 2000

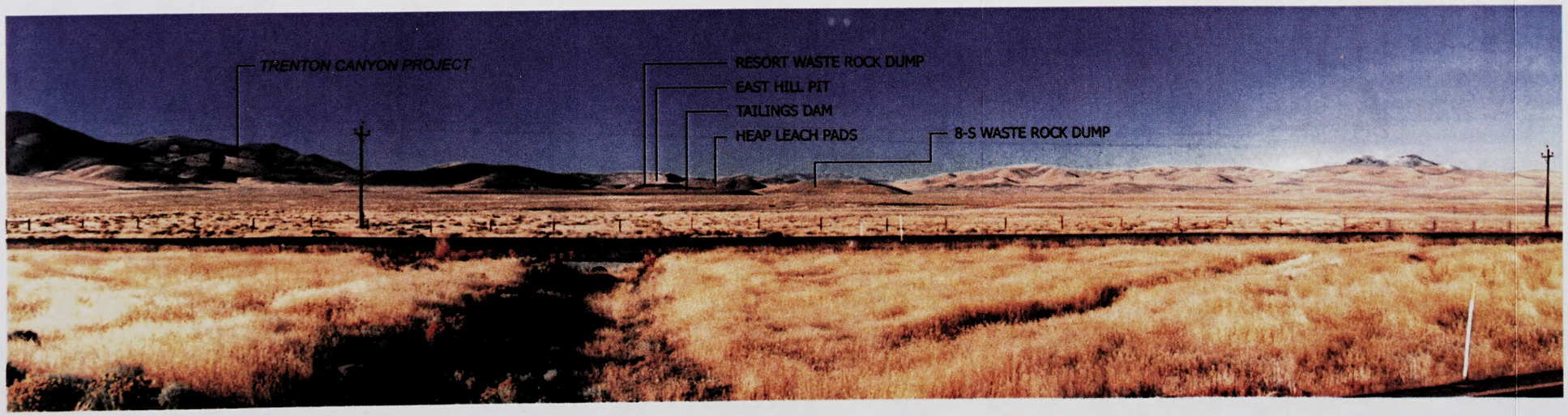
D-6





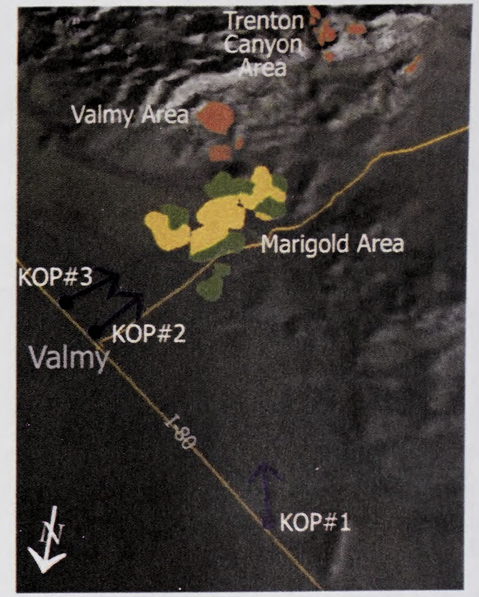



Simulation of Post-Reclamation Conditions




Existing Conditions Photograph

Note: For proper scale size, view images at 16" from eye.




Location Map

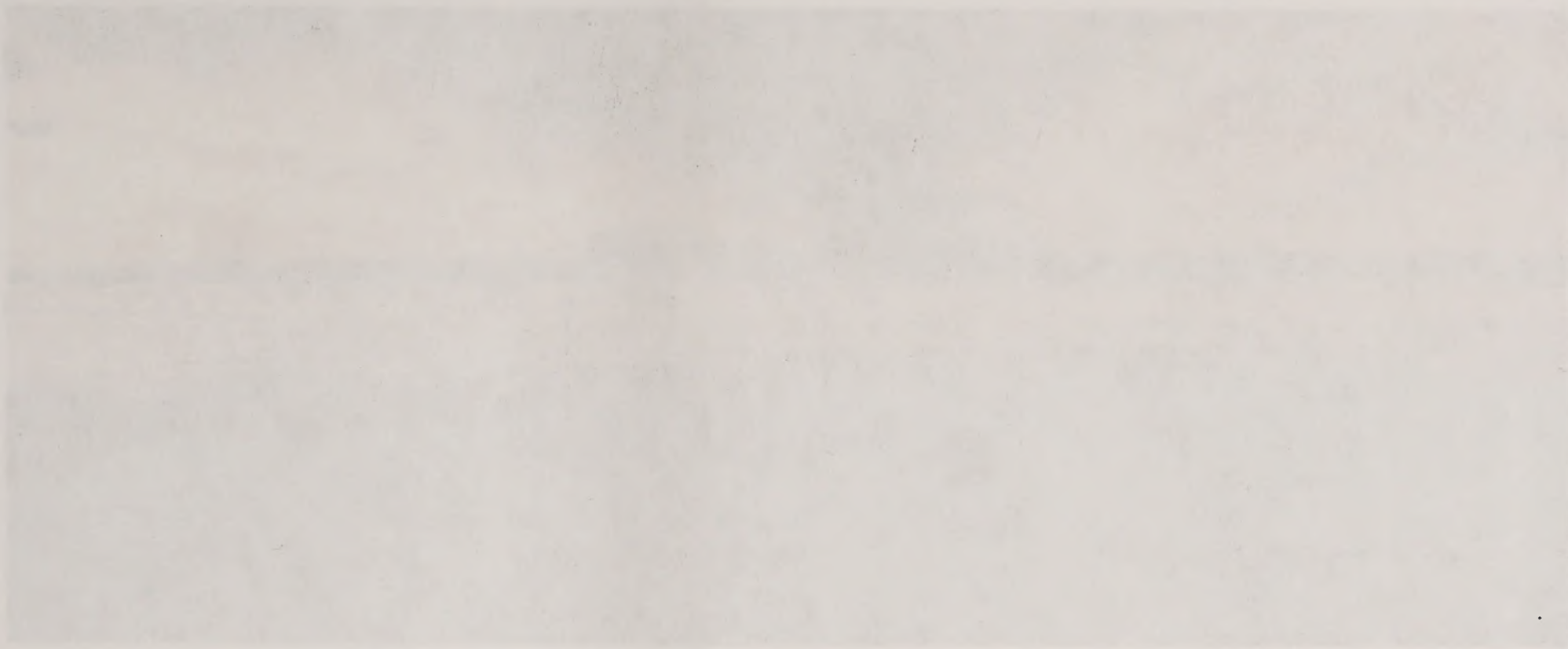
- Existing Marigold Mine Features
- Proposed Marigold Mine Features
- Proposed Trenton Canyon Project Features

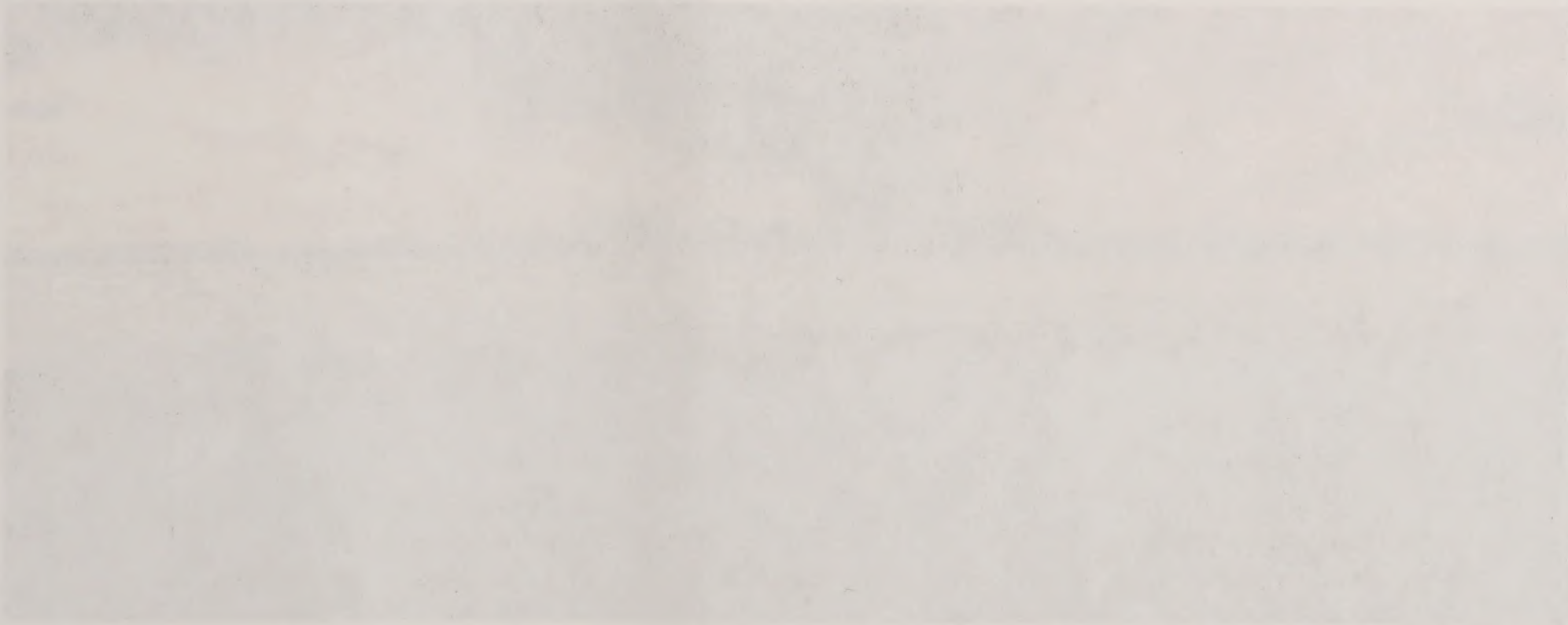
SIMULATION OF POST-RECLAMATION CONDITIONS
SOUTH OF VALMY, KOP#3

MARIGOLD MINE PROJECT
HUMBOLDT COUNTY, NV

EDAW
May 2000

D-6





Form 8400-4
(September 1985)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

# VISUAL CONTRAST RATING WORKSHEET

Date November 9, 1999

District Winnemucca

Resource Area

Activity (program) Minerals

## SECTION A. PROJECT INFORMATION

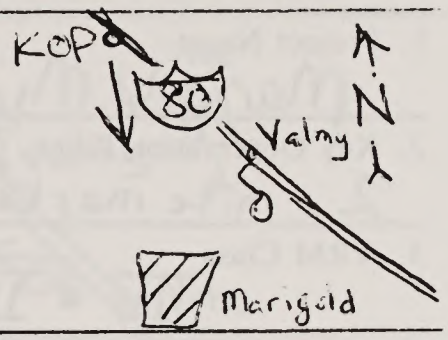
1. Project Name: Marigold Mine EIS

2. Key Observation Point: 1, milemarker 213, I-80

3. VRM Class: III & IV

4. Location
Township 33N
Range 43E
Section 8,9,18

5. Location Sketch




## SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

| | 1. LAND/WATER | 2. VEGETATION | 3. STRUCTURES |
|---|---|---|---|
| FORM | B - pyramidal<br>M - flat to rolling<br>F - flat | B - uniform<br>M - "<br>F - " | B - none<br>M - "<br>F - regular, narrow & cylindrical |
| LINE | B - convex & slightly jagged<br>M - straight & horizontal<br>F - none | B - discontinuous<br>M - none<br>F - discontinuous | B - none<br>M - "<br>F - parallel & vertical |
| COLOR | B - not visible<br>M - "<br>F - " | B - grey- to olive-green<br>M - straw<br>F - yellow green | B - none<br>M - "<br>F - dark brown |
| TEX-TURE | B - coarse<br>M - medium<br>F - fine | B - fine<br>M - fine<br>F - coarse | B - none<br>M - "<br>F - coarse |

## SECTION C. PROPOSED ACTIVITY DESCRIPTION (middleground) = M

| | 1. LAND/WATER | 2. VEGETATION | 3. STRUCTURES |
|---|---|---|---|
| FORM | M - squat rhomboids | M - none | M - none |
| LINE | M - straight, horizontal & converging | M - none | M - none |
| COLOR | M - dark brown | M - none | M - none |
| TEX-TURE | M - fine | M - none | M - none |

## SECTION D. CONTRAST RATING ☒ SHORT TERM ☐ LONG TERM

1. DEGREE OF CONTRAST

| ELEMENTS | FEATURES: LAND/WATER BODY (1) | | | | VEGETATION (2) | | | | STRUCTURES (3) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Strong | Moderate | Weak | None | Strong | Moderate | Weak | None | Strong | Moderate | Weak | None |
| Form | | | ✓ | | | | | ✓ | | | | ✓ |
| Line | | | ✓ | | | | | ✓ | | | | ✓ |
| Color | | | ✓ | | | | | ✓ | | | | ✓ |
| Texture | | | | ✓ | | | | ✓ | | | | ✓ |

2. Does project design meet visual resource management objectives? ☒ Yes ☐ No (Explain on reverse side)

3. Additional mitigating measures recommended ☐ Yes ☒ No (Explain on reverse side)

Evaluator's Names: Randall Rasmussen

Date: 11/9/99

Form 8400-4
(September 1985)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

# VISUAL CONTRAST RATING WORKSHEET

Date November 9, 1999

District Winnemucca

Resource Area

Activity (program) Minerals

## SECTION A. PROJECT INFORMATION

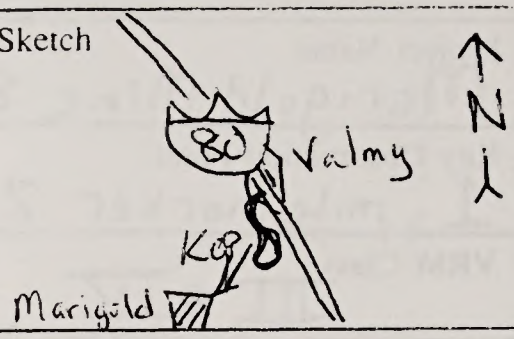
1. Project Name: Marigold Mine EIS

2. Key Observation Point: 2, mile marker 216, I-80

3. VRM Class: III & IV

4. Location
Township 33N
Range 43E
Section 8, 9, 18

5. Location Sketch




## SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

| | 1. LAND/WATER | 2. VEGETATION | 3. STRUCTURES |
|---|---|---|---|
| FORM | B - pyramidal<br>M - flat to rolling<br>F - flat | B - uniform<br>M - "<br>F - " to patchy | B - none<br>M - small & cylindrical<br>F - none |
| LINE | B - convex & slightly jagged<br>M - rolling<br>F - none | B - discontinuous<br>M - "<br>F - horizontal, feint | B - none<br>M - vertical<br>F - none |
| COLOR | B - not visible<br>M - "<br>F - " | B - grey- to olive-green<br>M - tan to grey-green<br>F - straw to brown | B - none<br>M - white<br>F - none |
| TEXTURE | B - coarse<br>M - fine to medium<br>F - fine | B - fine<br>M - fine<br>F - fine to coarse | B - none<br>M - medium<br>F - none |

## SECTION C. PROPOSED ACTIVITY DESCRIPTION (middleground = M)

| | 1. LAND/WATER | 2. VEGETATION | 3. STRUCTURES |
|---|---|---|---|
| FORM | M - squat rhomboids | M - absent | M - none |
| LINE | M - straight, horizontal & converging | M - none | M - none |
| COLOR | M - brown | M - none | M - none |
| TEXTURE | M - fine | M - none | M - none |

## SECTION D. CONTRAST RATING ☒ SHORT TERM ☐ LONG TERM

1. DEGREE OF CONTRAST

| ELEMENTS | FEATURES: LAND/WATER BODY (1) Strong | Moderate | Weak | None | VEGETATION (2) Strong | Moderate | Weak | None | STRUCTURES (3) Strong | Moderate | Weak | None |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Form | | ✓ | | | | | | ✓ | | | | ✓ |
| Line | | ✓ | | | | | | ✓ | | | | ✓ |
| Color | | ✓ | | | | | | ✓ | | | | ✓ |
| Texture | | | ✓ | | | | | ✓ | | | | ✓ |

2. Does project design meet visual resource management objectives? ☒ Yes ☐ No (Explain on reverse side)

3. Additional mitigating measures recommended ☐ Yes ☒ No (Explain on reverse side)

Evaluator's Names: Randall Rasmussen

Date: 11/9/99

Form 8400-4
(September 1985)

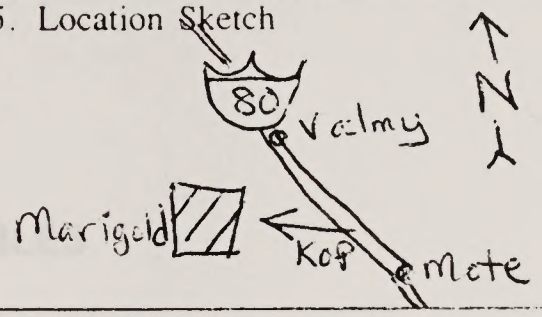
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

# VISUAL CONTRAST RATING WORKSHEET

Date: November 9, 1999
District: Winnemucca
Resource Area:
Activity (program): Minerals

## SECTION A. PROJECT INFORMATION

1. Project Name: Marigold Mine EIS
2. Key Observation Point: 3, mile marker 218.4, I-80
3. VRM Class: III & IV
4. Location
   Township: 33N
   Range: 43E
   Section: 2
5. Location Sketch




## SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

| | 1. LAND/WATER | 2. VEGETATION | 3. STRUCTURES |
|---|---|---|---|
| FORM | B - rolling<br>M - flat to rolling<br>F - flat | B - uniform<br>M - "<br>F - " | B - none<br>M - small & square<br>F - regular, narrow & cylindrical strip |
| LINE | B - convex & rolling<br>M - rolling to straight & horizontal<br>F - none | B - discontinuous<br>M - none<br>F - discontinuous | B - none<br>M - parallel & vertical<br>F - parallel & vertical, flat & horizontal |
| COLOR | B - not visible<br>M - beige<br>F - not visible | B - grey to olive-green<br>M - olive-green & straw<br>F - straw, grey-green | B - none<br>M - white<br>F - dark brown, grey / black |
| TEXTURE | B - coarse<br>M - medium to coarse<br>F - fine | B - fine<br>M - fine<br>F - fine to coarse | B - none<br>M - medium<br>F - coarse, fine |

## SECTION C. PROPOSED ACTIVITY DESCRIPTION (middleground = M)

| | 1. LAND/WATER | 2. VEGETATION | 3. STRUCTURES |
|---|---|---|---|
| FORM | M - rhomboids w/ stair-step edges | M - absent | M - none |
| LINE | M - parallel, horizontal & numerous | M - none | M - none |
| COLOR | M - beige / light brown | M - none | M - none |
| TEXTURE | M - fine to medium | M - none | M - none |

## SECTION D. CONTRAST RATING ☒ SHORT TERM ☐ LONG TERM

1. DEGREE OF CONTRAST

| ELEMENTS | FEATURES: LAND/WATER BODY (1) | | | | VEGETATION (2) | | | | STRUCTURES (3) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Strong | Moderate | Weak | None | Strong | Moderate | Weak | None | Strong | Moderate | Weak | None |
| Form | | ✓ | | | | | | ✓ | | | | ✓ |
| Line | | | ✓ | | | | | ✓ | | | | ✓ |
| Color | | ✓ | | | | | | ✓ | | | | ✓ |
| Texture | | | | ✓ | | | | ✓ | | | | ✓ |

2. Does project design meet visual resource management objectives? ☒ Yes ☐ No (Explain on reverse side)

3. Additional mitigating measures recommended ☐ Yes ☒ No (Explain on reverse side)

Evaluator's Names: Randall Rasmussen
Date: 11/9/99

# APPENDIX E

# CULTURAL RESOURCES SITES TABLES

**Table E-1**
**Marigold Mine Project Area Cultural Resource Sites Located In the Area of Potential Effect (APE)**

| Site Number | Site Description | National Register of Historic Places Status[1] | State Historic Preservation Officer Concurrence | Eligibility[2] Criteria | Land Ownership | BLM Report Number/ Reference |
|---|---|---|---|---|---|---|
| Cr-NV-22-4244 | Lithic scatter | NEL | Becker May 9,1988 | – | Public | CR2-2236(P) (Harmon et al. 1988a) |
| Cr-NV-22-4245 | Lithic scatter | NEL | Becker May 9,1988 | – | Public | CR2-2236(P) (Harmon et al. 1988a) |
| Cr-NV-22-4246 | Lithic scatter, projectile point, bifaces | NEL | Becker May 9,1988 | – | Public | CR2-2236(P) (Harmon et al. 1988a) |
| Cr-NV-22-4247 | Original central area of the Marigold Mine (historic) | NEL | Becker May 9,1988 | – | Public | CR2-2236(P) (Harmon et al. 1988a) |
| Cr-NV-22-4362 | Lithic scatter | NEL | Becker May 9,1988 | – | Private | CR2-2236(Addendum) (Harmon et al. 1988b) |
| Cr-NV-22-6085 | Lithic scatter | E | Baldrica March 19, 1996 | d | Public and Private | CR2-2612 (Newsome 1994) CR2-2632 (Obermayr & Dugas 1995) CR2-2681 (Dugas 1995) |

Table E-1 (Continued)

| Site Number | Site Description | National Register of Historic Places Status[1] | State Historic Preservation Officer Concurrence | Eligibility[2] Criteria | Land Ownership | BLM Report Number/ Reference |
|---|---|---|---|---|---|---|
| Cr-NV-22-6086 | Lithic scatter, lithic source area | NEL | Baldrica March 28, 1996 Baldrica September 14, 1994 | – | Private | CR2-2612 (Newsome 1994) CR2-2632 (Obermayr & Dugas 1995) |
| Cr-NV-22-6087 | Historic trash scatter | NEL | Baldrica September 14, 1994 | – | UNR | CR2-2612 (Newsome 1994) |
| Cr-NV-22-6088 | Historic trash scatter | NEL | Baldrica March 28, 1996 Baldrica September 14, 1994 | – | Public | CR2-2612 (Newsome 1994) CR2-2632 (Obermayr & Dugas 1995) |
| Cr-NV-22-6089 | Historic trash scatter | NEL | Baldrica March 28, 1996 Baldrica September 14, 1994 | – | Public | CR2-2612 (Newsome 1994) CR2-2632 (Obermayr & Dugas 1995) |
| Cr-NV-22-6090 | Lithic scatter; historic trash scatter | NEV/UE (recommended as not eligible) | Baldrica September 14, 1994- in this letter the SHPO does not concur; recommends further testing | – | Public | CR2-2612 (Newsome 1994) CR2-2686 (Dugas 1996) |
| Cr-NV-22-6091 | Lithic scatter | NEL | Baldrica September 14, 1994 | – | Public | CR2-2612 (Newsome 1994) |

**Table E-1 (Continued)**

| Site Number | Site Description | National Register of Historic Places Status[1] | State Historic Preservation Officer Concurrence | Eligibility[2] Criteria | Land Ownership | BLM Report Number/ Reference |
|---|---|---|---|---|---|---|
| Cr-NV-22-6092 | Historic trash scatter | NEL | Baldrica<br>September 14, 1994 | – | Public | CR2-2612<br>(Newsome 1994) |
| Cr-NV-22-6093 | Historic trash scatter | NEL | Baldrica<br>September 14, 1994 | – | Public | CR2-2612<br>(Newsome 1994) |
| Cr-NV-22-6094 | Lithic scatter; historic trash scatter with livestock watering facilities | E<br>(Prehistoric component)<br>NEL<br>(Historic component) | Baldrica<br>September 14, 1994 | The SHPO letter states "SHPO concurs that HISTORIC property is eligible under criterion d", but the BLM recommendation is that the PREHISTORIC component is eligible. | Public | CR2-2612<br>(Newsome 1994) |
| Cr-NV-22-6199 | Lithic scatter | E | Baldrica<br>March 19, 1996 | d | Private & Public | CR2-2632<br>(Obermayr & Dugas 1995) |
| Cr-NV-22-6204 | Fire-cracked rock cluster, lithic scatter | E | Baldrica<br>March 19, 1996 | d | Public | CR2-2632<br>(Obermayr & Dugas 1995) |
| Cr-NV-22-6205 | Fire-cracked rock clusters, lithic scatter | E | Baldrica<br>March 19, 1996 | d | Public | CR2-2632<br>(Obermayr & Dugas 1995) |

Table E-1 (Continued)

| Site Number | Site Description | National Register of Historic Places Status[1] | State Historic Preservation Officer Concurrence | Eligibility[2] Criteria | Land Ownership | BLM Report Number/ Reference |
|---|---|---|---|---|---|---|
| Cr-NV-22-6235 | Lithic scatter | NEL | Baldrica<br>March 28, 1996<br>Baldrica<br>September 14, 1994 | – | Private | CR2-2632<br>(Obermayr & Dugas 1995) |
| Cr-NV-22-6239 | Lithic scatter | NEL | Baldrica<br>March 28, 1996<br>Baldrica<br>September 14, 1994 | – | Private | CR2-2632<br>(Obermayr & Dugas 1995) |
| Cr-NV-22-6240 | Lithic scatter | NEL | Baldrica<br>March 28, 1996<br>Baldrica<br>September 14, 1994 | – | Private | CR2-2632<br>(Obermayr & Dugas 1995) |
| Cr-NV-22-6251 | Historic trash scatter | NEL | Baldrica<br>March 28, 1996<br>Baldrica<br>September 14, 1994 | – | Private | CR2-2632<br>(Obermayr & Dugas 1995) |
| Cr-NV-22-6252 | Trash dump | NEL | Baldrica<br>March 28, 1996<br>Baldrica<br>September 14, 1994 | – | Private | CR2-2632<br>(Obermayr & Dugas 1995) |
| Cr-NV-22-6263 | Historic trash scatter | NEL | Baldrica<br>March 19, 1996 | – | Public | CR2-2681<br>(Dugas 1995) |

## Table E-1 (Continued)

**FOOTNOTES:**

[1]NR/UE - No recommendation; unevaluated.
RI/UE - Unevaluated; recommended ineligible.
RE/UE - Unevaluated; recommended eligible.
NEV/UE - Additional information required per agency recommendation; unevaluated.
E - Eligible to the NRHP with SHPO concurrence.
NEL - Not eligible to the NRHP with SHPO concurrence.
APE - Area of potential effect.

[2]National Register of Historic Places Eligibility Criteria:

a: Sites that are associated with events that have made a significant contribution to the broad patterns of history.

b: Sites that are associated with the lives of persons significant in our past.

c: Sites that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction.

d: Sites that have yielded, or may be likely to yield, important information on prehistory or history.

Total number of cultural sites within APE = 24.
Total number of NRHP-eligible or unevaluated sites within APE = 6

**Table E-2**
**Marigold Mine Project Area Cultural Resource Sites Located Within 500 Feet of the Area of Potential Effect (APE)**

| Site Number | Site Description | National Register of Historic Places Status[1] | State Historic Preservation Officer Concurrence | Eligibility[2] Criteria | Land Ownership | BLM Report Number/ Reference |
|---|---|---|---|---|---|---|
| Cr-NV-22-4698 | Small lithic scatter | NEL | James July 24, 1989 | – | Public | CR2-2294 (Clay 1989) |
| Cr-NV- 22-4699 | Small lithic scatter | NEL | James July 24, 1989 | – | Public | CR2-2294 (Clay 1989) |
| Cr-NV-22-6195 | Small lithic scatter | E | Baldrica March 28, 1996 | d | Public | CR2-2632 (Obermayr & Dugas 1995) |
| Cr-NV- 22-6196 | Lithic scatter; historic trash scatter | NEL | Baldrica March 28, 1996 Baldrica September 14, 1994 | – | Private and Public | CR2-2632 (Obermayr & Dugas 1995) |
| Cr-NV-22-6242 | Small trash scatter | NEL | Baldrica March 28, 1996 | – | Private | CR2-2632 (Obermayr & Dugas 1995) |
| Cr-NV-22-6246 | Fire-cracked rock cluster | E | Baldrica March 28, 1996 | d | Private | CR2-2632 (Obermayr & Dugas 1995) |
| Cr-NV-22-6247 | Fire-cracked rock cluster | E | Baldrica March 28, 1996 | d | Private | CR2-2632 (Obermayr & Dugas 1995) |
| Cr-NV-22-6248 | Fire-cracked rock clusters; lithic scatter | E | Baldrica March 19, 1996 | d | Private | CR2-2632 (Obermayr & Dugas 1995) |
| Cr-NV-22-6264 | Debitage and tool scatter; base camp | E | Baldrica March 19, 1996 | d | Public and Private | CR2-1681(P) (Dugas 1995) |
| Cr-NV-22-6375 | Intermediate Prehistoric camp | NEL | Baldrica October 18, 1996 | – | Private | CR2-2686(P) (Dugas 1996) |

Table E-2 (Continued)

| Site Number | Site Description | National Register of Historic Places Status[1] | State Historic Preservation Officer Concurrence | Eligibility[2] Criteria | Land Ownership | BLM Report Number/ Reference |
|---|---|---|---|---|---|---|
| Cr-NV-22-6376 | Lithic scatter, base camp; historic stone alignments and trash scatter | E (prehistoric component)<br>NEL (historic component) | Baldrica<br>October 18, 1996 | d | Public and Private | CR2-2686(P)<br>(Dugas 1996) |
| Cr-NV-22-6377 | Lithic scatter | NEL | Baldrica<br>October 18, 1996 | – | Private | CR2-2686(P)<br>(Dugas 1996) |

[1]NR/UE - No recommendation; unevaluated.
RI/UE - Unevaluated; recommended ineligible.
RE/UE - Unevaluated; recommended eligible.
NEV/UE - Additional information required per agency recommendation; unevaluated.
E - Eligible to the NRHP with SHPO concurrence.
NEL - Not eligible to the NRHP with SHPO concurrence.
APE - Area of potential effect.

[2]National Register of Historic Places Eligibility Criteria:

a: Sites that are associated with events that have made a significant contribution to the broad patterns of history.

b: Sites that are associated with the lives of persons significant in our past.

c: Sites that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction.

d: Sites that have yielded, or may be likely to yield, important information on prehistory or history.

Total Number of Sites Within 500 feet of APE = 12

Total Number of NRHP-eligible or unevaluated sites within 500 feet of APE = 6

# APPENDIX F

# CULTURAL RESOURCES SIGNIFICANCE CRITERIA

# APPENDIX F
# CULTURAL RESOURCES SIGNIFICANCE CRITERIA

The significance of a cultural heritage resource is an assessment of its importance to the citizens of the United States and indicates whether a site has attributes that qualify it for inclusion on the NRHP. In order to be considered eligible for the NRHP, a cultural resource must be a district, site, building, structure, or object that retains its integrity of location, design, setting, materials, workmanship, feeling, and association, and satisfies at least one of the four significance criteria defined in 36 CFR part 60.4. These criteria include:

- Part 60.4a - sites that are associated with events that have made a significant contribution to the broad patterns of history;
- Part 60.4b - sites that are associated with the lives of persons significant in our past;
- Part 60.4c - sites that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction;
- Part 60.4d - sites that have yielded, or may be likely to yield, important information on prehistory or history (Parker and King no date).

Cultural heritage sites also are considered significant if they are protected under other state or Federal statutes, such as the Native American Graves Protection and Repatriation Act or the Nevada Indian Burial Protection Act (Nevada Regulations Statutes 383.150), which outlines procedures regarding treatment of human burials on state or privately-owned land in Nevada.

An undertaking has an effect on a cultural property if it alters any of the characteristics or criteria that may qualify the property for inclusion on the NRHP or otherwise affects a property's legally protected status. Impacts to cultural heritage resources are considered adverse if the effect diminishes the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Adverse effects can include, but are not limited to:

- Direct physical disturbance, damage, or alteration of all or part of a site or property that is listed on or is eligible for the NRHP, or is protected under state and/or other Federal statutes;
- Isolation of the property from or alteration of the character of the property's setting;
- Introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting;
- Neglect of a property resulting in its deterioration or destruction; and
- Transfer, lease, or sale of the property (36 CFR, 800.9, revised as of July 1, 1994).

Discussions of project impacts are limited to sites within the proposed mine area deemed to be significant or eligible for inclusion on the NRHP or sites that have Federal and/or state protection under other statutes.

Effects of an undertaking that have been found to be adverse as described above may be considered not adverse when:

- The property is of value only for its potential contribution to archeological, historical, or architectural research, and when that value can be preserved through appropriate research conducted in accordance with applicable professional standards and guidelines. This applies only to those sites identified as eligible to the Register under Criterion "D" and mitigated under treatment plans approved by the applicable agencies.

- The undertaking is limited to rehabilitation of structures that preserves the historical and architectural value to the property, and when transfer, sale, or lease includes restrictions or conditions that ensure the preservation of the property's significant features (36 CFR 800.9 (c)(1-3).

Sites eligible to the Register under Criteria A, B, and C that may experience adverse effects from the undertaking can sometimes be mitigated through such methods as development of educational centers or kiosks that provide information on the affected properties. Mitigation for sites nominated under Criteria A, B, and/or C that would experience adverse effects must be developed and defined in a treatment plan approved by the appropriate agencies.

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